Encyclopedia Edinensis

6 vol

Storage above

410 microscop.

THE

ENCYCLOPÆDIA

EDINENSIS.

ENCYCLOPÆDIA EDINENSIS:

OR

DICTIONARY

OF

ARTS, SCIENCES, AND LITERATURE.

IN SIX VOLUMES,

INCLUDING ALL THE MODERN IMPROVEMENTS TO THE PRESENT TIME; AND ILLUSTRATED WITH UPWARDS OF ONE HUNDRED AND EIGHTY ENGRAVINGS.

KNOWLEDGE IS POWER.—Bacon.

VOLUME FIRST.

EDINBURGH:

PUBLISHED BY JOHN ANDERSON, JUN. 55, NORTH BRIDGE STREET, EDINBURGH; COWIE, LOW, & CO. LONDON; RICHARD BURDEKIN, YORK; AND WILLIAM CURRY, JUN. & CO. DUBLIN.

MDCCCXXVII.

PREFACE.

In announcing the completion of the Encyclopædia Edinensis, the Proprietor begs leave to assure the subscribers, that, in conducting this undertaking, it has uniformly been his study not only to fulfil, but even to exceed the expectations held out in the prospectus. He, therefore, feels much satisfaction in being enabled now to present to the public this work, embracing almost all the departments of human knowledge in a form so concise, and at the same time so complete, without transgressing the limits originally proposed. Although unavoidably deprived of the valuable co-operation of the original Editor, Dr. James Millar, he may still be permitted to congratulate the subscribers, that the arrangements he has effected, have been such as cannot fail to satisfy them, that the respectability of the Publication has been successfully supported, and that neither labour nor expense has been wanting on his part to bring it to a speedy and satisfactory termination. The public will now be enabled to form a proper estimate of its merits, not only regarding the selection of the materials, but also in respect to the quantity of matter contained in each volume, compared with that of any contemporary publication of the same kind. To such as are denied the advantage of public libraries, and of numerous and expensive publications, this work, which admits of being so easily carried about from one place or country to another, cannot fail to be extremely valuable, since it contains, within a narrow compass, the essence of all the information we possess respecting the different countries of the world, and not only delineates the boundaries and extent of every continent, state, and kingdom, on the globe, but also contains a distinct view of the political, moral, and commercial condition of each; thus furnishing a convenient register of knowledge, digested in an easy and agreeable form, and containing an immense variety of remarkable and valuable facts, which no memory can accurately retain, and which, were it not for such compositions, might occasion no small expense, and no little time and labour to investigate. The extended details and profound discussions, on abstruse subjects, which abound in most Encyclopædias, have justly been complained of, as unsuitable to a numerous class of readers; and the magnitude and great expense of such works, preclude not a few from the benefits which they are so eminently calculated to afford. From a persuasion, therefore, that many of the works of this nature are not only too expensive, but also too voluminous and inconvenient for general use, the Encyclopædia Edinensis was originally projected; and it will be found not only to obviate these inconveniences, but, from its moderate size, and the style of its execution, will be accommodated to a more extended circle of readers than any popular work of a similar description.

While the various treatises on the higher branches of science form a prominent feature in this Encyclopædia, the subjects of miscellaneous literature, and of history, both ancient and modern, occupy at the same time their adequate proportion, and, instead of indulging in extraneous speculations, the primary object uniformly kept in view, has been to promote useful knowledge, to mingle instruction with amusement, and to render the different branches of science perspicuous and intelligible to readers of every class. The accounts of the different empires, and the descriptions of the inferior districts or counties which they contain, have been entirely written anew. The larger treatises on scientific subjects have been drawn up with the greatest care by professional men of eminent talents, and have either been methodically arranged under different heads, with a running title, or furnished with a copious and accurate index, so as to render a more particular division superfluous. The political changes that have taken place in the various countries of the world, as well as the wonderful moral and scientific revolutions which have lately occurred, have also been brought under the review of the reader, while the discoveries and improvements recently made in all the branches of experimental philosophy, have been duly examined and discussed. That interesting and important branch of knowledge which records the lives of eminent men, particularly the biography of distinguished *literary characters*, will be found to be very complete, having been drawn from the most authentic sources, and brought down to the latest period of publication. The science of geography has been rendered particularly interesting by the Maps which accompany this treatise; and the public, it is hoped, will find that the great divisions of the earth, and of particular countries and states, have been *accurately delineated*. The drawings intended to illustrate the various subjects treated of, have also been executed with great taste and precision, and are elegantly engraved by the most eminent artists. In such a work as this, so diversified and extensive, mistakes, inaccuracies, and omissions, may naturally be expected, and all that the proprietor can venture to hope on this point is, that they are not very numerous, and perhaps fewer than will be found in most publications of a similar kind.

The Proprietor ought not to omit acknowledging his obligations to those friends and literary gentlemen, to whose inspection the treatises contained in it have been occasionally submitted, and some of whom have largely contributed to the merits of this undertaking, by the numerous original treatises they have furnished on various subjects. Among these he is proud to announce the names of the original editor, Dr. James Millar, Dr. Jeremiah Kirby, and Dr. Richard Poole of Edinburgh. The labours of these three principal contributors to this work have been so extensive, that, to enumerate them individually, would occupy a greater space than the limits of this Preface will allow. It may be sufficient to state, that Dr. Millar, besides his almost innumerable minor contributions, as editor of the first Eighteen Parts, has contributed most of the principal treatises in that division of the work, especially Bleaching, Botany, Chemistry, *Galvanism*, (under Electricity,) and Geology. Dr. Kirby, among his numerous contributions, has furnished the whole department of Medicine, except Midwifery, including Anatomy, Dietetics, Materia Medica, Medicine, *Human* and *Veterinary*, and Surgery; he has composed many of the principal Zoological Treatises, especially Bee, Entomology, Erpetology, Helminthology, and Ichthyology; some of the most important Geographical and Historical articles, as Geography, Hanover, New Holland, Ireland, Judæa, Russia, Sweden, Switzerland, and Turkey; several prominent treatises on some of the Chemical Arts, as Brewing, Dyeing, Fire-Works, and Glass Manufacture; and some treatises on Experimental Philosophy, particularly Electricity, Optics, and Pneumatics. Dr. Poole, in addition to other contributions, has furnished the treatises on Architecture, Education, Language, Mathematics, Mind, Philology, Philosophy, and Phrenology. It may be satisfactory to the reader also to learn, that the articles Astronomy and Dialling were compiled by George Buchanan, Esq. Civil Engineer, Edinburgh; Magnetism and Meteorology, by the Rev. Dr. Russel of Leith; Design, by Patrick Gibson, Esq. of the Dollar Institution; and Mechanics, by the Rev. David Liston, Calcutta; that the treatise on Midwifery was furnished by John Dick, M. D. Mid-Calder; and that on Music, by the Rev. Henry Liston of Ecclesmachen. Besides various geographical and historical contributions by the Rev. Thomas Nelson, and the Rev. Alexander Duncan, Mid-Calder, the former composed the treatise on Religion, and the latter the articles Miracle, Name, Necker, Prejudices, Pyramids, and Reformation. The history of the Polar Expeditions, and the Essay on Sports and Pastimes, together with numerous small contributions in volumes fifth and sixth, were furnished by Mr. Alexander Anderson; Theology, also America, South, in the Addenda, by Mr. Walter Tod; and Navigation, by Mr. William Galbraith, Teacher of Mathematics, Edinburgh. Among the other distinguished individuals to whom the proprietor is indebted for assistance in the execution of this work are, the Rev. James Couper, D. D. Professor of Practical Astronomy in the University of Glasgow, and Lockhart Muirhead, LL. D. Professor of Natural History, the latter of whom composed the treatises on Ophiology and Ornithology; also Robert Wallace, A. M. Professor of Mathematics of the Andersonian Institution in that city, who conducted, and who furnished the greater part of the contributions in the Addenda in volume sixth, and the Preliminary Dissertation in the first volume. In addition to these may be mentioned the names of the Rev. John Adamson of Newton; of Messrs. James Flint, Land-Surveyor, Robert Macmillan, John Wallace, Teacher of Mathematics, Edinburgh, and Alexander Peterkin, late Sheriff-substitute of Orkney; also that of the Rev. John Sommers, D. D. who superintended the publication of the last Twelve Parts of this work, and who, besides supplying a great variety of articles in the departments of Geography and Biography, not only contributed the treatises on Plant and Planting, Poor and Poor Laws, Railway, Road, Stipend, Teinds and Tithes, together with Antiquities, Prophecy, and Revenue, in the Addenda, but also furnished a considerable portion of the treatises on Mammalia, Missions, and Moral Philosophy. To his friends Sir William Hamilton, Bart. and his brother Thomas Hamilton, Esq. the proprietor has also been indebted for many useful suggestions and other occasional assistance in the execution of the work. Besides these, several other individuals of distinguished talents have contributed their literary labours and friendly assistance, but their names it is wholly unnecessary here to particularize. Most of the gentlemen above mentioned have been long known in the republic of letters, by their numerous and valuable contributions to the Britannica, the Edinburgh Encyclopædia, Metropolitana, and similar works of great literary merit. The publication of the fourth edition, and of the last 15 volumes of the fifth edition of the Encyclopædia Britannica, was conducted under the able superintendence of Dr. Millar, while Dr. Kirby, Dr. Poole, and Dr. Muirhead were likewise among the principal contributors to that valuable publication.

Encyclopædias of various kinds have now been long in use, and have been read and consulted with great avidity, both by the learned and unlearned, throughout the various nations of Europe. From the number and variety of these publications, one of which may be considered as constituting the library of many an individual who has neither much time nor much money to dispose of, the reader may be enabled to form a tolerably correct idea of the progressive improvement of the sciences and of literature, since as they approached the standard of real excellence and perfection, books of this kind seem to have multiplied in proportion. Most of these Encyclopædias will be found, on examination, to be only copies of such as have preceded them, with additions, corrections, and improvements, adapted to the state of the sciences at the period when they were published; and some of them, indeed, which profess not to be original, but mere compilations, will, on examination, be found to be the most correct, the best arranged, and the most valuable. By this means all repetitions and extraneous matter are excluded, which cannot possibly be the case with such as consist wholly of original essays and contributions, as every writer is apt, more or less, to touch upon kindred topics connected with the subject on which he writes.

At a very early period, Lexicons, Dictionaries, and other works similar to an Enclyclopædia, were published under different titles, some of which were excellent and valuable at the time, and evinced in the compilers, marks of great industry as well as a wonderful degree of useful information. Pliny's *Natural History* was esteemed a work of this kind, as it included all that the ancients comprehended under that head. Alfarabius, who is mentioned by Casiri as a celebrated Arabian writer of the tenth century, is said to have composed a work which treats of the liberal Arts and Sciences, to which he gave the title of Encyclopædia. Another curious publication of this kind is that of Scalichius *Paulus* de Lika.—*Encyclopædiæ, seu Orbis Disciplinurum, tam Sacrarum quam Prophanarum, Epistemon. Basileæ,* 1559, in quarto. In 1638, the title of Encyclopædia was likewise given to a Dictionary of the Arts and Sciences, published in two volumes, folio, by J. H. Alstedius, a German author of no inconsiderable talent and erudition. To this succeeded the "*Idea Encyclopediæ Mathematico-Philosophicae,*—Erhardi Weigelii, which was published in 1657. After this, in 1661, appeared "*Caspari Schotti Cursus Mathematicus, Libris* 28, *sive Encyclopædia omnium Disciplinarum Mathematicarum;*" and in 1668 the "*Lexicon Mathematicum*" of Vitalis. There was also published in 1573, a curious work similar to an Encyclopædia, which was reprinted at Strasburgh in 1579, under the title of "Lexicon, *seu Dictionarium Mathematicorum in quo Definitiones et Divisiones continentur Scientiarum Mathematicarum, Arithmeticae, Logisticae, Geometriae, Geodesiæ, Astronomiae, Harmoniae,—M. Conrado Dasypodio,* Auctore." In 1598, this was followed by the "*Tabula Artium et Professionum Mathematicarum,*—Lazari Schoneri." A work of very considerable merit was also published at Paris in 1690, under the title of *Dictionnaire Mathematique,* by Ozanam. In 1706, Dr. Harris gave to the world his *Lexicon Technicum,* or *Universal Dictionary of Arts and Sciences;* and in 1710, the second volume of that valuable production, to which was added a supplement, to bring down the improvements in the sciences to 1736, and before 1741 it had gone through five editions. For a long time this excellent work furnished materials for many succeeding compilations of the same kind. Subsequent to this appeared the "*Compendieuses Gelehrten-Lexicon,*" by H. D. John Burkhard Menken; the *Lexicon Mathematicum* by Wolfius; and the *Mathematical Dictionary* by Stone; followed by a host of inferior productions of a similar kind.

To these succeeded a work of very superior merit, the Cyclopædia of Chambers, in 2 vols. folio, first published in 1727, which greatly surpassed in style and execution all that had gone before it. In the short space of eighteen years this valuable work had seen no less than five editions; and it was rendered still more valuable by a large supplement of two additional volumes to another edition, all of which were embodied by Dr. Abraham Rees in 1786, in 4 vols. folio. This publication, by the united labours of Dr. Rees and Dr. Price, was rendered still more complete, and has within these few years been given to the world in a finished form, consisting of 40 volumes quarto, besides six volumes of splendid engravings.

A vast number of other productions of a similar nature, many of them of great celebrity, have, within the last century, been published in Germany and France. The most distinguished of these are Ludwig's "*Grosses Volstaendiges Universal Lexicon,*" published in 1732, in 68 volumes folio. The *Encyclopedié, ou Dictionnaire Raisonnée des Sciences des Arts et des Metiers,* of Diderot, D'Alembert, &c. 28 vols. folio, with a supplement of five additional volumes. This great work was begun in 1751, and completed in 1772, and the supplement, which was begun in 1776, was finished in 1778. The same work was also published at Geneva nearly at the same period, and also at Yverdun, in 58 quarto volumes; and a few years afterwards at Lausanne, in 39 volumes, royal octavo. Being again new-modelled at Paris, it was published under the title of *Encyclopedié Methodique,* by a society of literary gentlemen, in which the arts and sciences are included in separate treatises; so that this great undertaking comprehends not fewer than 40 separate Dictionaries; and when completed will exceed in magnitude any work of a similar kind, as nearly 150 vols. quarto, were completed before the French Revolution interrupted the publication.

Several other works under the title of Dictionaries and Encyclopædias also appeared about this time in Britain, such as Owen's New and Complete Dictionary of Arts and Sciences, which possesses no small degree of merit. It consists of 6 vols. octavo, and has gone through several editions since it was first published in 1754, and has furnished materials for various subsequent compilations. We may here also mention the Encyclopædias of Proctor, Croker, Clark, Castieau, Hall, Barrow, Howard, and Gregory; the British, English, London, Imperial, Domestic, Oxford, and Edinburgh Encyclopædias; the Portable, and the New Cyclopedias; the Pantalogia, the Perthensis, and the Metropolitana. To these may be added a great variety of particular Dictionaries on separate branches of science, such as the Medical Dictionaries of Quincy, James, Motherby, Parr; the Chemical Dictionaries of Nicholson, of Aikins, and of Macquer; Dictionaries on Law by Cunningham, Burn, and by Giles Jacob, improved by Tomlins; on Gardening, by Millar, Dickson, and Martyn; on Numismatology, by Guesseine and Rasch; the Marine Dictionaries of Falkoner and Chapman; Dictionary of Architecture by Felibien; Dictionaries of Music by Rousseau, Hoyle and Busby; Mortimer and Postlethwaite's Dictionaries of Trade and Commerce; Hutton's Mathematical and Philosophical Dictionary; and Barlow's excellent work of the same kind; Smith's Panorama of Science and Art; also his Mechanic, or Compendium of Practical Inventions; with smaller works of this kind almost without number.

But the most valuable Encyclopædia that has hitherto been completed in Britain, and one that eclipsed all that had gone before it, was the Britannica, first published in 3 vols. at Edinburgh, 1771. Several improved and enlarged editions of it soon afterwards appeared, and in 1800 it was again revised and extended to 20 vols. quarto, by a supplement of 2 vols. under the superintendence of Dr. Gleig. This masterly work has now passed through six editions, and has lately been greatly improved and enriched by a splendid supplement of 6 vols. making in all 26 vols. quarto. Two works of great merit, already noticed, are also in progress of publication, the Edinburgh Encyclopædia and the Metropolitana, which, when completed, will do honour to their conductors. The first of these follows the plan of the Britannica in the form of a Dictionary, and the latter, that of the French works, which include separate sciences or dictionaries under a philosophical and an alphabetical arrangement.

The prodigious number of Encyclopædias and Dictionaries of a similar nature that have been published during the last century, clearly proves that the public is extremely partial to works of this description; so that while the arts and sciences continue to improve, such literary productions may be expected to increase. Whether the present work will add to the value and respectability of such publications, remains for the subscribers and the public to determine.

Edinburgh, October, 1826.

HISTORICAL DISSERTATION

ON THE

ORIGIN AND PROGRESS OF THE ARTS AND SCIENCES.

THE origin of the Arts and Sciences is, like that of nations, involved in obscurity and fable. Knowledge began to dawn upon the human race in those genial climes that are first illuminated by the rising sun; and, like that luminary, though its early rays were comparatively feeble, yet they were, in the progress of civilization, gradually rendered more brilliant by the fire of superior genius, till they ultimately reached a state of meridian splendour. The useful arts which sprung up in the infancy of the world, are but slightly mentioned in Holy Writ, and of the antediluvian ages we have no other record. According to the traditions delivered by Josephus, the science of Astronomy was first cultivated by the sons of Seth, and the discoveries of those early observers of the heavenly bodies, were, for the benefit of posterity,

"On flood-surviving pillars deep enroll'd."

After the flood, many ages elapsed before Science assumed a consistent and systematic form. When mankind began to relinquish a wandering and savage life,—when the Nimrods of the primitive periods of society had ceased to hunt their fellows like beasts of prey,—when conventions were held, and general laws established for the common good,—and when, by universal consent, it was agreed that every one should provide for his own subsistence, without seizing on the property of another,—then, necessity, self-preservation, and domestic comfort, the great springs of physical exertion, gave rise to the most useful Arts. Houses were built, iron was forged, the land was divided, and the courses of the stars were observed. Nor is it remarkable that Astronomy should have been among the first of the Sciences; it was necessary even to Agriculture. The spontaneous productions of the earth were insufficient for the support of man approaching to civilization; useful plants and fruits required labour and cultivation to bring them to a state of perfection; and as the ground brought forth only at stated periods, it was necessary to regulate the operations of agriculture by the seasons of the year. The observations for these purposes, at first rude and unskilful, were connected with Science by a secret tie, though for many ages, experience and custom were the only guides.

At length arose some aspiring genius, who, collecting the traditionary knowledge, observations, and aphorisms of earlier times, formed them into a system, ill-arranged, perhaps, and incongruous at first, but sufficient to point out to mankind the progress of knowledge, and its immense advantages to society. The magnificent spectacle which the vast field of nature presented to the senses and imagination of man, was then beheld with new feelings of delight; he learned to examine the parts of which it was composed and to compare them with each other; his powers were increased and his condition ameliorated by the process; ideas acquired from physical objects were transported into an intellectual world; the phenomena of nature were studied with a discriminating attention, and desires were excited in the mind to ascertain the causes by which they were produced. The fine feeling expressed in that line of the Roman poet,

"Felix qui potuit rerum cognoscere causas,"

had then its due influence on the early improvers of Science. Geometry originating at first in the art of measuring the fields, was extended to other departments of knowledge, and gave rise to loftier and more difficult problems. Astronomy was enriched by a regular succession of observations, and though the spring of the mighty movements of the celestial bodies lay long concealed from the scrutiny of mortals, the most useful phenomena were obvious to the ordinary observer.

The invention of machines for the abridgment of human labour soon followed, if they were not contemporaneous with the expansion of intellect which such researches originated. The Mechanic Powers must, in some form or other, have been early suggested to mankind. There is no age, indeed, so ignorant and barbarous, in which we can imagine them to have been unacquainted with the use of levers and wheels, so necessary for the transportation of heavy loads and the erection of stupendous structures. The superiority of each successive age consisted only in the skilful combination and application of these simple powers. Science has ever in such cases lent her powerful aid, and enabled the philosopher to wield the ordinary powers of nature with a gigantic force and skill. Such must have been the early history of human knowledge; in all probability its progress would have been more rapid, had not fanaticism and ambition frequently obscured the light of genius for a long series of ages. As a fire, however, concealed beneath the embers, it has been relumed in happier times, at the inspiration of a kindred flame, and has at length burst forth upon the world, with that blaze of intellectual glory which now so brightly irradiates the greater portion of the habitable globe.

The Fine Arts, which have ever possessed charms for mankind, more powerful than those of Science or even the useful arts, owe their origin and commanding influence to an immediate comparison with nature. The expression of the passions in the simplest and most natural language and tones of voice, laid the foundation of the kindred arts of Poetry, Music and Eloquence. The delineation of the objects of those passions on the first smooth surface that presented itself, or the formation of their image in the first soft mould that was subjected to the pressure of the hand, became, in like manner, the basis of the sister arts of Painting, Statuary, and Sculpture. The same causes which gave an early origin to the Fine Arts, produced in them an early degree of excellence. They seem to have shot up at once into perfection, long before the phenomena of nature and her laws had become the subject of philosophical investigation. With the exception of Astronomy, none of the physical sciences seem to have arrived at any thing like system, previous to the composition of the noblest specimens of the fine arts. The supernatural effects ascribed to the Lyre of Orpheus, of Linus, and of Musæus, sufficiently show the splendour of their achievements. The Promethean animation given to the lifeless statue, and the grandeur and simplicity of the epic poem, form an early and a striking contrast to the feeble advances made in the history and economy of the material world. The summit of excellence to which Homer, Thucydides, Demosthenes, Apelles, and Phidias, reached in their respective spheres, while mankind were ignorant of the great laws of the universe and the causes of the most common natural appearances with which they were surrounded, must appear remarkable to us, while contemplating the efforts of the moderns in the very dawn of their Literature and Science. It would seem as if men, satisfied with the first efforts of their ideal powers, or awed by the grandeur of their conceptions when embodied in forms surpassing their expectations, were willing to let fancy gloat on the images before them, and cared not to exert the imagination, much less the reason, on pursuits of a higher and more exalted nature.

Thales and the Ionic Sect. The period, however, approached when a new and more useful impulsion was to be given to the human mind. The glimmering twilight which had so long overspread the nations was about to be dispelled. The lamp of Science which had hung so long concealed in the fanes of eastern idolatry and superstition, bedimmed by the gloomy and debasing artifices of Chaldean magi, and enveloped in the mystery of Egyptian priests, was about to be relumed in more favoured climes. The sages of Greece travelled into foreign countries, visited the seats of ancient learning, and returned fraught with the wisdom of the east. A host of eminent men arose in succession, and shed a glory over their native land. The Ionic sect of philosophers was founded by Thales about six centuries before the Christian era. With him the authentic periods in the history of Science seem to begin. Though, previous to this period, the Chaldeans boasted of celestial observations at Babylon for 1600 years, and the Egyptians for a period nearly as ancient; and though Cadmus had, 850 years before, introduced the Phenician letters into Greece; yet the ascertaining the height of a pyramid by means of its shadow was considered an achievement worthy of this early sage. The geometrical propositions, however, which he is said to have discovered, in addition to his astronomical knowledge,—particularly the foretelling of an eclipse,—entitle him to higher praise. His successors, Anaximander, and Anaximenes, continued the Ionian line, and taught the doctrines of the same school under various modifications. Though the knowledge of nature possessed by those early philosophers was but superficial, it was not the less aspiring. They conceived every substance to be composed of four elements, fire, air, earth and water, but combined in various proportions. Earth and water were considered as naturally ponderous and inert, while air and fire were fancied to be endued with elastic virtue, and possessing lightness and activity. According to this system, the earthy matter settled towards the centre, while the aqueous fluid rolled along the surface of the globe. The air and fire, or æther, soared aloft,—the former filling up the whole of the sublunary region, and the latter streaming through the boundless extent of space. The same pure lambent fluid, collected into globular masses, formed the groups of stars; while portions of its divine essence descended to animate terrestrial beings and communicate the vital spark. These notions, so like the colouring of fantastic dreams, were no doubt firmly believed in former ages, and, by their influence on the vulgar mind, became powerful auxiliaries to the worshippers of the muses.

Seven Sages of Greece. The degree of civilization to which the Greeks had now arrived, tended greatly to foster the spirit of speculation. The legislator Solon, about this period, promulgated his laws at Athens; those of Lycurgus having been established about a century before, at Sparta. The great questions of law and government had thus early attracted the attention of mankind. At the court of Periander, king of Corinth, were the seven sages of Greece assembled, and each of them was asked, "which is the most perfect popular government." Bias replied, "That where the laws have no superior;" Thales said, "That where the people are neither excessively rich nor miserably poor;" Anacharsis answered, "That under which virtue is honoured and vice detested;" Pittacus said, "That where dignities are conferred only on virtue;" Cleobulus said, "That which inspired more fear of blame than of punishment;" and Chilo, "That under which the laws are more regarded than the orators;" Solon's decision, which was esteemed the wisest, was, "That government where an injury done to the meanest citizen is considered as an insult to the whole community." Such were the invaluable maxims which formed the basis of the legislature of Greece, and held up to the admiring world examples truly worthy of imitation, in jurisprudence and civil polity. The Olympic Games, which had been instituted at a very early period, (about thirteen centuries before the Christian era,) had been revived by Iphitus king of Elis, and afforded the philosophers, poets, historians, and orators of Greece, the grandest arena for the display of their talents, that ever graced the annals of any country. Before their assembled countrymen they strove who should excel in all that was worthy of being called great or good among men, and the spirit of emulation thus excited was productive of the happiest effects. Learning and the arts flourished apace, and being freed from the trammels of despotism, under which they had languished in the country of their birth, rose to an eminence far surpassing that of the countries of the east, hitherto the most celebrated in the world.

Pythagoras. Soon after the periods of which we have been speaking, arose one of the most eminent sages of antiquity. Pythagoras, who flourished about five centuries before our era, was the founder of the Italian school, and was the first who assumed the modest, but auspicious, name of *Philosopher.* He was a native of the island of Samos; and on his return from those travels into Egypt, Persia, and India, during which he had acquired that vast fund of knowledge for which he was so renowned, he was viewed with awe and veneration by his countrymen during the celebration of the Olympic games. Aware of the prejudices of mankind, those idols which Lord Bacon long afterwards so fancifully, but justly described, he cautiously introduced those doctrines to public notice, wherein he differed from the mass. A long probation alone rendered his disciples able and willing to receive those truths which constituted the tenets of his philosophical creed. The study of Mathematics appears to have been absolutely necessary for the comprehension of some of his doctrines. Certain it is that these sciences were indebted to him for some fine discoveries, particularly, that respecting the relation between the sides and the hypotenuse of a right angled triangle, which now forms the forty-seventh proposition of the first book of Euclid's Elements,—a theorem more essential to the perfection of Geometry, than any that can be named; and if we may judge by the story of his sacrificing a hecatomb to the Muses on the occasion of its discovery, he seems to have had a foresight of the magnificence of the edifice that was, in after ages, to be built on its foundation. Pythagoras also brought Music to a great degree of perfection, both in theory and practice. Having his imagination, like that of Kepler in modern times, full of the beautiful relations and properties of numbers, which he cultivated with the greatest enthusiasm, he is said to have transferred his musical ideas to the harmony of the celestial motions. Arriving, by the force of his genius, to the sublime conception of the true system of the universe, he is supposed to have veiled the noble discovery under a splendid allegory. Under the symbol of Apollo playing on the lyre, he is said to have taught his chosen disciples, that all the planets, including the earth, are inhabited worlds, revolving round the sun as a common centre; and, to have maintained that those bodies, while they circle round that great luminary, perform a most harmonious concert, though such ravishing and heavenly sounds are lost to our gross ears, and drowned amid the jarring noise which prevails below. This great philosopher is also believed to have been the first who discovered that Lucifer and Hesperus, or the morning and evening star were the same planet, and made that noble conjecture respecting the milky way, so finely alluded to by Milton:

> "Which nightly, as a circling zone, thou seest
> Powdered with stars."

Grecian Poets. The genius of Greece was now rapidly advancing to her zenith. Her tragic and lyric poets had kindled their torch at the lamp of philosophy, which now shone with an uncommon splendour over that favoured country. Though epic poetry had long ago reached its summit of excellence in the immortal poem of Homer, yet the passions and the feelings, and even the understanding, as well as the moral sense, were called into a higher field of contemplation, by the splendid compositions of the three great tragic poets, Æschylus, Sophocles, and Euripides, who flourished between 500 and 460 B. C. Their works abound with the sublimest flights of imagination and eloquence that ever graced mere human writing. What, for instance, can equal the following passage from the "Œdipus Tyrannus" of Sophocles, even though it labours under the disadvantage of translation:—" O for a spotless purity of action and speech, according to those sublime laws of right, which had the ethereal heavens for their birth-place, and God alone for their author—which the decays of mortal nature cannot change, nor time cover with oblivion; for the divinity is mighty within them, and waxes not old!" The sublimity of Pindar, the loftiest of the Grecian lyric poets, who flourished a few years before the tragedians, is perhaps superior to that of the latter; but it is of a kind less calculated to rouse the more amiable feelings and moralities of our nature. This is no doubt owing to the loftiness of his subjects, which were connected with all that was reckoned noble and praiseworthy by his countrymen. He sung those celebrated games of Greece, " quorum pars magna fuit," and was himself rewarded in the very place and manner which he has rendered immortal in his songs. It is a remarkable fact in the history of the world, that a number of eminent men have always appeared at the same time. The immortal Phidias arose at this period, and produced those splendid works of which it is the lament of the moderns that some fragments and descriptions only remain. However much, indeed, they may have excelled the ancients in the ethical and physical sciences, all their progress in the Fine Arts, falls far short of the Parthenon, and the statues of Minerva and Jupiter Olympius. Such achievements as those, require a genius, like Phidias, whose whole soul, filled with the gorgeous visions of the elder time—the dark legends of gigantic strength—and the feelings of a power and a glory departed from men,—shall catch the spirit of ages gone with the years before the flood, and transmit it to after generations in the most durable of earthly memorials.

Grecian Philosophy. Philosophy kept pace with the march of intellect and liberty in Greece. The doctrines of Pythagoras were promulgated by his disciples, of whom the most eminent was Empedocles, the Sicilian, who flourished about this period. He seems to have had some obscure notions of the theory of attraction and repulsion in the corpuscular philosophy. Xenophanes, the founder of the Eleatic sect, drew some accurate geological conclusions from the discovery of marine fossils in the bowels of the earth, and on the tops of the highest mountains, inferring that the exterior crust of our globe had, at some remote period, been submerged under the waters of the ocean. His follower Leucippus, anticipated the idea of a centrifugal force. But it was reserved for Democritus, who flourished during the Peloponnesian war, to extend, correct, and improve these doctrines of his predecessors. He made considerable advances in natural philosophy, and rectified the erroneous notions which prevailed before his time, respecting the existence of a plenum and a vacuum, and levity, as attributed to the elements of air and fire. He discovered the fundamental principles, that the weight of bodies is proportional to their mass, and that they would fall in the same time, in a vacuum. From his acquirements and learning, Lucretius, in his elegant poem on the "Nature of Things," bestows on him the fine appellation of "pater et rerum inventor."

Confucius. While philosophy and the arts were thus rapidly extending in Greece, an eminent philosopher had made his appearance in the East. China, a country which has always made great pretensions to high antiquity, early civilization, and remote astronomical observations, had produced the great Confucius, who flourished about four or five centuries before the Christian era. This philosopher, who has been called the Socrates of the east, is chiefly celebrated for his moral and political maxims, as, like the Grecian philosopher, he turned his attention almost entirely to the moral improvement of his countrymen. Much has been said by modern infidels respecting the excellence of the maxims of Confucius, especially as regards the duty of man to man. It is affirmed that he inculcated our Saviour's golden precept, "Do unto others, as you would that they should do unto you;" but the same sentiment was expressed by several of the Grecian sages, and by Cicero, very nearly in the same words. What, however, do such facts prove, or how do they in any way invalidate the divine mission of Christ? He did not come to abrogate the law originally impressed on man's heart and conscience, but to establish that law by new and more powerful motives. Every good feeling and sentiment that arose in the human mind, was an emanation from the divinity; and it would be wonderful indeed if the author of the sublimest system of morals that was ever promulgated to the world, should not have adopted any maxim that so manifestly bore a divine impress, however well it might have been known, or by whomsoever it might have been at first appropriated. He who, in the beginning of time, made the worlds,

> "Who rounded in his palm those spacious orbs,
> And bowl'd them flaming through the dark profound,"

required not the assistance of heathen philosophers, in laying down rules of conduct for his disciples. As in the regions of external nature, the produce of a thousand hills was his, so in those of philosophy and morality, the gems of truth which sparkled amid the rubbish of many ages, were his unquestionable property, and could only be restored to their pristine purity and situation in the Christian code, by their original author.

Socrates arose at a period when philosophical sects had increased so much throughout Greece, that the true end of knowledge seemed to be abandoned for the love of system. This philosopher, who flourished at Athens about 400 B. C. was eminent for the sublimity of his genius, the simplicity of his manners, and his happy talent for investigating truth and exposing error. Disgusted with the absurd sophisms and vain pretensions of many of his contemporaries, he forsook the study of nature founded on mere speculation, and recommended that philosophy alone which is established on fact and experiment. He justly considered that the first step to real knowledge was to discover our ignorance; hence he took pleasure in exposing every kind of hypocrisy and false learning. The method he adopted, which is denominated the *Socratic Dialogue*, was well calculated to produce the effect he desired; by seeming to be desirous of acquiring a knowledge of the opinions and systems of individuals, he drew from them such concessions in the course of conversation, as showed the absurdity of their tenets; these he afterwards employed to overthrow their imposing and flimsy fabric, by turning their own arguments against themselves. His chief object was to diffuse instruction among the body of the people, rather than to confine it to a few. Hence he is finely said to have been the first sage who brought philosophy down from heaven to earth. We would willingly draw the veil over the close of the life of this illustrious man, when we reflect that truth and virtue have too often been ill rewarded, even though they escaped the glory of martyrdom.

Platonic School. Plato, the most eminent of his disciples, soon rivalled his master in fame. He was distinguished both as a philosopher and a mathematician. He imbibed his taste for the pure sciences while he studied the doctrines of the Pythagoreans. In the grove of Academus, near Athens, under the shade of spreading planes, he taught the youths of Greece those sublime tenets of his mystical philosophy, which laid the foundation of his after renown. He was the inventor of the beautiful method of Geometrical analysis, which became so powerful an instrument in directing the investigations of succeeding geometers, and extending the boundaries of Science. He is said to have been the discoverer of the Conic Sections. Certain it is, however, that before his time comparatively little progress had been made in geometry, as a science, and that he considered this kind of knowledge a necessary qualification in his disciples. The mensuration of rectilinear figures was no doubt long known, its origin being ascribed to the Egyptians; but Hippocrates of Chio appears to have been among the first who attempted to find the area of curvilinear figures. Foiled in his attempts at the quadrature of the circle, he discovered the method of squaring that portion of it called a *lune.* The problem of finding *two mean proportionals* excited much interest at this period. It is said to have arisen from that proposed by the oracle at Delos, *to double the cube,* the solution of which was to allay the plague which then raged in Attica; a fiction probably invented to give an air of importance and mystery to the problem. Though this problem is impracticable by plane geometry, yet it was solved both by mechanical construction and the resources of the higher geometry, which was cultivated in the time of Plato. He himself, his master Archytus, and his scholars Eudoxus and Menechmus gave solutions of it, the latter of whom, especially, deserved praise for his method, as being the first known application of the geometric *loci* and the *conic sections.* The *trisection of an angle,* another problem beyond the limits of plane geometry, gave rise to new discoveries in the Platonic school. The *quadratrix* was invented by Deinostratus. The properties of the five *regular solids* were also investigated by the Platonists; hence they were denominated the *Platonic bodies.* Geometry was applied soon after this period to Astronomy, by Eudoxus and Autolycus.

Aristotle, the most comprehensive genius of antiquity, called the Stagyrite from the place of his birth, flourished about 360 years B. C. He was the illustrious disciple of his illustrious master Plato. As his celebrated pupil Alexander aimed at the universal conquest of the civilized and barbarian world, so he sought to embrace both the natural and moral, within the single grasp of his capacious mind. Though he founded the Peripatetic school at the Lyceum, yet the progress of his opinions in Greece was little, compared with that despotic sway which they for ages maintained in Europe, over the learned. It is said by some historians that he was the author of 4000 volumes, of which scarcely twenty are now extant. No philosopher, either in ancient or modern times, ever took such a vast range of disquisition, and yet he is remarkable for soundness of judgment, precision of thought, and singular acuteness. His great work on Natural History, is a wonderful production, when we consider the period of its appearance. He was the founder of Comparative Anatomy, and the improver of Meteorology, Mechanics, Physics and Astronomy. In his works on these subjects, amid much useless matter, there are to be found many fine remarks and just conclusions, and not a few interesting doctrines worthy of a better day. He wrote treatises also on Mathematics and Music, and the fragments of these which have escaped the ravages of time, prove the great extent of his knowledge in these sciences. His Rhetorics and Poetics are such master-pieces of their kind, that they have never yet been excelled, and the moderns still bow implicitly to their laws, while his authority in Natural Philosophy and Metaphysics has long since been exploded. His *Organon,* now deemed the most useless of all his works, and certainly, as a method of discovering truth or detecting error, perfectly futile, is still valuable for the *synthetic* mode of instruction which it unfolds, and which is still followed in the mathematical sciences.

Alexandrian School. It is a remarkable fact that the exact sciences not only flourished in Greece when literature and the fine arts existed in their greatest splendour, but continued to advance after the latter had become retrograde. Poetry, eloquence, and sculpture, soon began to decline, while all parts of the pure and mixed mathematics were rapidly extending. A short, but brilliant period only has been allowed, in most countries, to original excellence in the literature and arts which depend upon the imagination. The exercise of that power, seems, like the liberty of the turbulent republics, to lead, after a few generations, to its slavery; but the reason, a better governed kingdom, goes on making acquisitions which are imperishable, and perpetually accumulating. The science and literature of Athens, that once mistress of the intellectual world, were transferred to the other countries bounded by the shores of the Mediterranean, and particularly cherished by Ptolemy king of Egypt, one of the sharers of the vast and unwieldy empire of Alexander. The school of Alexandria, founded by this prince, in the magnificent edifice styled the Musæum, and enriched with an immense library and a splendid observatory, produced an extraordinary succession of eminent men. This royal establishment was for nearly 1000 years, the resort of the most illustrious geniuses of ancient times, and conferred incalculable benefits on the human race. A host of the ablest mathematicians shed a lustre on the first three centuries of the Alexandrian school. Euclid, one of its brightest ornaments, digested his immortal *Elements of Geometry,* and raised a monument to his fame,

> "Quod non imber edax, non Aquilo impotens
> Possit diruere, aut innumerabilis
> Annorum series, et fuga temporum."

This lucid genius wrote treatises also *on Conics, plane loci,* and *porisms,* a species of geometrical proposition, which, after being involved in obscurity for ages, from the loss of his work, was elucidated by three eminent mathematicians of modern times, Simson, Playfair, and Brougham. The works on Music, Astronomy, Optics, and Mechanics, ascribed also to Euclid, will at least not lessen his merit, when we consider the early period at which they were written. Accurate Astronomical observations were first made in the Alexandrian Observatory, by Aristillus and Timocharis, about 300 B. C. The astronomical poem of Aratus, entitled "*Phenomena,*" illustrative of the opinions of Eudoxus the Pythagorean, and so popular among the ancients, as to be translated by Cicero and Germanicus, was written shortly after this period. Paul, in his admirable sermon at Athens, makes the following quotation from this poem, when speaking of the *Unknown God* whom they ignorantly worshipped:—"*του γαρ και γενος εσμεν.*"

Archimedes. The most inventive genius which antiquity ever produced, was the much-famed Archimedes, a native of Syracuse, who flourished 250 B. C. The achievements of this philosopher in pure science were only excelled by his real discoveries in Natural Philosophy, which first took its genuine form under his plastic hand. He gave an unlimited extent to the notation of numbers, and founded the method of indivisibles, which led him to the finest discoveries in Geometry. By this means he determined the area of the parabola, the first curve that was exactly quadrated; he made a very near approximation to the quadrature of the circle, and unfolded the beautiful relations that subsist between the cylinder and its inscribed cone and sphere. He was the first who illuminated the sciences of Mechanics and Hydrostatics by the light of Geometry, and his advances were accordingly splendid and triumphant. He appears to have been the first who noticed the centre of gravity in bodies, and he determined it in a number of figures. The properties of spirals and of conoids and spheroids were also among his discoveries. He developed the principles of equilibrium in floating bodies, and thus traced the elements of naval Architecture. He was the first who demonstrated the properties of the lever and some other mechanic powers, and who showed their vast practical application. The story of his boast is well known: "Δος που στω και την γην κινησω." The detection of the fraud in the fabrication of Hiero's golden crown, on the principles of specific gravity, is equally notorious. His success in applying his immense mathematical and mechanical knowledge to practice, in defending his native city from the Romans, have conferred no less renown on his name. The powerful engines which he constructed enabled his countrymen to resist, for three years, the united efforts of the fleet and army of the enemy; and it is to be regretted, for the honour of science, that the relaxation of their ordinary vigilance one fatal night should have laid their city open to stratagem, and involved it in the horrors of an assault, which terminated alike the mortal career of this amazing genius, and their own existence as a wealthy and independent state. The skill of Archimedes appears to have shone equally in Astronomy and Optics as in other branches of Natural Philosophy. Of his discoveries in the former, no accounts remain, except of his determination of the sun's apparent diameter, by a very accurate method, and his deduction from thence of its distance from the earth; he is said also to have constructed a machine for exhibiting the motions of the heavenly bodies, so remarkably ingenious, that Cicero employs the fact as an argument against those who denied the existence of a God. Among his optical inventions, that of burning mirrors, and their wonderful effects, are well known. The fact of the Roman vessels being set on fire by their means, during the siege of Syracuse, was long doubted till its practicability was demonstrated by Buffon.

Aristarchus and Eratosthenes. The broad and ample base of the pyramid of science had been now laid, and the irrefragable and eternal truths of Geometry had for ever rendered it impossible to be shaken. Astronomy began to extend its domains. Aristarchus of Samos had devised an ingenious mode of determining the distances of the sun and moon, made an observation of the solstice, and attempted to revive the Pythagorean system of the universe, which had been rejected by Aristotle. Eratosthenes, a mathematician of the Alexandrian school, determined the obliquity of the ecliptic to be $\frac{11}{83}$ of the circumference, and had the honour of being the first who measured an arc on the surface of the earth. He invented the *Sieve*, a method of finding prime numbers, and several other ingenious mathematical contrivances. His literary and poetical acquirements, in addition to his scientific talents, procured him the esteem of his contemporaries, as a universal genius.

Apollonius of Perga, a genius scarcely less illustrious than Archimedes, was distinguished among the ancients by the name of the *Great Geometer*, and flourished at the Musæum, about 200 B. C. He obtained this noble appellation from his discoveries in the *Conic Sections*, on which he wrote a treatise in four books, the last three being his own invention. In this work so wonderfully did he display his powers in the management of the ancient geometry, that he treads on the threshold of some of the finest modern discoveries. The lost treatises of this great genius, of which the titles were given by Pappus, have exercised the ingenuity of the most skilful of the modern mathematicians, in their attempts to restore them. The problem of *tactions*, was solved by Vieta and Newton. The *sections of ratio and space*, were restored by Halley. The problem of *determinate section* was resolved by Simson. The problems of *inclinations* and *loci plani* were also restored by Simson and others. With Apollonius the progress of the Greek Geometry in the Alexandrian school seems to have terminated, and the labours of his successors were either turned to the improvement of Astronomy, or confined to the writing of commentaries on the works of those gigantic geometers who had spread such a glory around that ancient temple of science.

Hipparchus of Bithynia, who has been styled the father of Astronomy, flourished at Alexandria about 140 B. C. He discovered the precession of the equinoxes, and the inequality of the periods between those points. He approximated very nearly to the exact length of the year, ascertained the distance of the moon, and rectified that of the sun. The motion of the signs of the zodiac *in antecedentia*, suggested to Hipparchus the idea of ascertaining and registering the positions of the principal fixed stars; he also made a catalogue of eclipses for 600 years; thus he laid the basis of the first Astronomical Ephemeris. He was likewise the first who determined the latitudes and longitudes of places on the surface of the globe by celestial observations. The appearance of a new star in the heavens led him to the grand conjecture of the motion of the stars which were considered fixed, a discovery which has so recently been established by Herschell, South, and Struve. Overlooking, however, the true notion of the solar system, he unfortunately introduced the hypothesis of Eccentrics and Epicycles to explain the inequalities of the sun's motion, which, being afterwards adopted by Ptolemy, proved an enormous incumbrance to science.

Ptolemy. The next philosopher of note in the Alexandrian school, was Ptolemy the Astronomer, who flourished at a period about as long after the Christian era, as Hipparchus did before it. He was a most excellent and indefatigable observer, and he not only improved every branch of Astronomy, but he corrected the errors of Hipparchus and others, and digested the multifarious discoveries that had been made before his time, along with his own, into one great system, which he published under the title of the "μεγαλη Συνταξις," or "The great Construction," called by the Arabians, "Almagest." He discovered the evection of the moon, and wrote a treatise on Optics, in which he explained the nature of atmospherical refraction. He was also the author of a work on Geography, in which he applied the theory of projections, which he had invented, to the construction of maps. The study of spherical trigonometry was begun by Hipparchus, extended by Theodosius and Menelaus, but reduced to a practical form by Ptolemy. He adopted and exhibited in his great work, the ancient system of the world, which placed the earth in the centre of the universe, and which has been named after him, the Ptolemaic system. Other philosophers of the Alexandrian school applied themselves to mechanics, but their advances, compared with those of Archimedes, were feeble and insignificant. The genius of Greece, which by this time was fast sinking under oppression, was at length evaporated in unsuccessful struggles for liberty,—and with liberty fled every thing that was valuable in art, science, or philosophy. The Romans had now become masters of the world, and humble imitators of the Greeks, they never produced, during the whole period of their empire, a single genius in those valuable branches of human knowledge, that could equal, much less surpass the achievements of that ingenious people.

After the decline of the Roman empire, and the burning of the Alexandrian library—that storehouse of the collected wisdom of ages—Europe had fallen into such a convulsed state, by the irruption of Northern hordes, that science was totally neglected, and every thing gave way to the ravages of war, and the overwhelming tide of religious superstition. The Arabians actuated by the fierce spirit of a false religion, which had newly sprung up in their quarter of the globe, began to spread the terror of their arms in all directions. Having overrun Egypt, Syria, and Persia, in the East, they turned towards the West, made themselves masters of Spain, and, penetrating into the interior of France, threatened at last to extinguish the very name of Christianity. Checked, however, by the rudeness and poverty of the natives, or by the inhospitality of less favoured climes, and perhaps satiated with the thirst of conquest, they soon abated the fervour of their warlike zeal, and their ambitious enterprizes at last yielded to the arts of peace. Fortunately some remains of Grecian Literature and Science had escaped the general conflagration of the works of the ancients, and the Arabians, under the influence of a spirit that reflects on them the highest honour, carefully collected all that could be found of the philosophical writings of that wonderful people, and caused them to be translated into their own language. Their princes rewarded such undertakings with unbounded liberality; they filled their palaces with those precious relics of science; and, attracted by the beauty of astronomical researches, they adorned their courts by the erection of splendid observatories.

Arabians. The intimate connection of Geometry with Astronomy led the Arabians to cultivate both sciences with ardour; and, destitute of the speculative genius of the Greeks, they turned their efforts chiefly to their practical application. Hence they soon became expert calculators and accurate observers. Almamoun, the son of the celebrated Haroun al Reschid, who reigned at Bagdad in 814, observed the obliquity of the ecliptic and measured the length of a terrestrial degree in the plains of Mesopotamia. Of the astronomers protected by this prince and his successors, Albategni was the most eminent. He ascertained, in 880, the eccentricity of the solar motion, and discovered the change of the place of the sun's apogee. Ibn Junis, at Cairo, in 1000, determined the length of the year, within 2′ of the truth. To the Arabians we owe several improvements in Trigonometry. They first employed the *sines* of angles instead of the *chords*, and introduced the *tangents* into their calculations. Arithmetic took from them that permanent form which it has since preserved by the introduction of the decimal notation—one of the most important steps that was ever made in the progress of Science. This beautiful and simple invention they did not arrogate to themselves, but acknowledged that they borrowed it from the nations of India. The use of these Indian characters was carried by them into Spain, whence it was transferred to the rest of Europe.

Croisades. During these enlightened periods of Arabian history, the fairest portions of Christendom were enveloped in intellectual darkness. The savage arts of war and the intrigues of a cunning priesthood, had conspired to reduce man to a state little better than that of absolute barbarism. His restless and uncontrolable spirit was, in these times, forced to expend its energies in the severest sports, or the most wanton depredations. Science, during these middle ages, was reduced to a very low ebb; it was preserved, however, from becoming totally extinct. The pilgrimages which were undertaken to the shrines of saints, and the visits paid to Rome from every corner of Europe to which her influence extended, served still to keep alive the feeble light of knowledge which had survived the wreck of ages. The Croisades, those expensive armaments which were raised during the period from the twelfth to the fourteenth century,

"when the peers
Of Europe, by the bold Godfredo led,
Against the usurping infidel display'd
The blessed cross, and won the Holy Land,"

are regarded by many as the main cause of the renovation of the human mind in the West. The intercourse produced, during the cessation of hostilities, between the Croisaders and the Saracens who surpassed them in knowledge and refinement, as well as the information obtained by foreign travel, tended greatly to advance the former in the knowledge of the arts and sciences which had been driven from Europe. To this origin is ascribed many of the subsequent improvements which had a polishing and invigorating effect on the progress of society. During these benighted periods, when the streams of ancient philosophy had been almost completely dried up, and no trace left of their source, several useful arts arose, which were destined to lend their valuable aid to the advancement of science. The making of paper was invented about the year 1100, and was the first step to that immense stride afterwards made by the art of printing. Salvino Degli Armati constructed convex lenses for spectacles about the year 1285, thus still farther preparing the way for the use of that grand invention.

Roger Bacon, who flourished in the thirteenth century, was the most eminent natural philosopher of that period, and his name shines like a star amid the general gloom. He appears to have anticipated several chemical and philosophical discoveries of later times. The invention of the magic lantern and telescope has been attributed to Bacon, though, probably, his attempts merely showed others the way; he was acquainted with the construction of certain locomotive carriages, and aeronautic machines; and he gives a description of the diving-bell. It is said that he was familiar with the properties of gunpowder, though the invention has been attributed to Schwartz, a German monk, who lived at a later period. The eastern nations were, however, early acquainted with the deflagrating property of nitre, which was introduced into Europe by the Croisaders, and probably the art of making gunpowder itself. This invention has wonderfully extended the empire of man over Nature, and may indeed vie with the art of printing, in those improvements which they have mutually introduced into society. Wars have been rendered less frequent and sanguinary than in ancient times, by the expense attending the raising of armies, while the arts of peace, have been greatly indebted to its tremendous power in tearing asunder solid rocks of stone. It appears not to have been employed in Europe till about the year 1330; artillery was first used by the Moors at the siege of Algesiras, in 1334; and in 1346, King Edward employed four pieces of cannon, at the memorable battle of Cressy.

Mariner's Compass. The Greeks, though acquainted with the attractive power of the magnet, seem to have been ignorant of its wonderful property of pointing towards the north, the discovery of which is attributed to the Chinese. The Croisaders are alleged to have brought a knowledge of this discovery from the east; but it was first employed in Navigation, by Gioja of Amalphi, near Genoa, about the year 1260. The declination of the magnetic needle seems to have been known very soon after the discovery of its directive property, as it is mentioned by Peter Adsiger in a MS. dated 1269. Aided by this wonderful invention, man soon ventured to explore the utmost limits of the ocean, and wandering, at first, in fear and uncertainty, wasguided by an irresistible power to the discovery of a New World. The thirst for knowledge had begun to rouse the latent energies of human ingenuity, when an invention occurred which may be justly esteemed its noblest achievement, when we reflect on the incalculable benefits it has conferred on our race.

> " 'Tis to the pen and press we mortals owe
> All we believe, and almost all we know."

The art of Printing is said to have been first invented at Haerlem, about 1430, but it is generally attributed to the ingenuity and perseverance of Schoeffer and Guttenberg, assisted by the wealth and the patronage of Faust, a citizen of Mentz. It was introduced into England by William Caxton, and in the short space of thirty years arrived very nearly to that high degree of perfection in which it now exists. The art of painting, which had been revived by Cimabue about the time of Roger Bacon, received at the same period, such a wonderful improvement, by the invention of engraving, that its divine productions were rendered as imperishable as the works of Literature and Science by that of printing. Those who studied the manuscripts of antiquity, which had escaped the ravages of time and the barbarity of nations, now saw a field opened for the exertions of genius which had never been anticipated by the most sanguine expectations of philosophers. Their most ardent hopes for the means of advancing science was infinitely surpassed. Much was to be done, however, before this great invention could be rendered useful to the mass. The repositories of the ancient treasures were to be made accessible; the knowledge of the languages in which they were written was to be acquired; the manuscripts were to be decyphered, and the skill of the grammarian and the critic were to precede that of the mathematician and the philosopher.

Literary Establishments. The monasteries and other religious endowments afforded an asylum to the explorers of ancient lore, and part of the ample revenues of the Romish church were dedicated to the education of youth. Separate academies were established for the purpose of communicating the higher degrees of instruction, and the adoption of the Latin language as the common medium of intercourse over Europe, greatly facilitated the progress of learning. When these seminaries were so much extended as to comprehend all branches of liberal knowledge, they were denominated "General Studies;" and, afterwards, when they were sanctioned by the Bulls of the Roman pontiff, and protected by law, they received the title of "Universities." In these schools, the opinions of Aristotle, which formed the highest object of study, were expounded with incredible diligence, and their authority was held paramount to that of the Holy Scriptures. Thus, the vigour of early genius which, if better directed, might have risen to sublime discovery, was speedily wasted in idle disputations, and, at length, exhausted in empty subtleties. The study of letters, though productive of no immediate advantage to that of nature, still prepared the mind of man for the reception of her great truths. Poetry, as in the infancy of time, began first to attract his attention after the renovation of his powers. Dante and Petrarch resorted to the pure fountains of ancient learning which had been discovered, and the deep enthusiasm and eloquence of the latter poet, produced a great impression on the minds of his contemporaries. The Greek language began to be cultivated, and the princely patronage of the family of Medici, diffused a general taste for literature. The dispersion of the men of letters, occasioned by the taking of Constantinople in 1453 by the Turks, was the cause of the transportation of the remains of Greek Philosophy and Roman Literature to Italy, where they were happily preserved from oblivion.

Arts and Manufactures. The civilization which the Romans introduced into Britain seems to have been either forgotten or very little improved, till the period of Alfred the Great. In his time the English goldsmiths began to excel, and before the conquest, the woollen manufactures had risen to a considerable degree of perfection. About 1250, the linen manufacture seems to have been considerably advanced in England, though embroidery was then much practised. In the twelfth century, silks were principally worn in Sicily. The manufacture of cloth was greatly improved, by the establishment of Kempe and other Flemish weavers in England, in the fourteenth century; and numerous mechanical arts were advanced, about the same period, by the invention of wire-drawing, which was first introduced at Nuremberg. The great increase in the arts of civilization and refinement in the succeeding centuries, produced a greater demand for superior manufactures. This required more labour and skill, and suggested to some happy genius of superior penetration, the great principle of the *division of labour*, by which each individual is enabled to acquire so high a degree of perfection in a single branch of the arts or manufactures, that the whole is much more perfectly and expeditiously performed, than if it had been the entire workmanship of any one artist, though possessed of far greater abilities and experience. The invention of the modern spinning wheel is attributed to Jurgen of Brunswick, in 1530, and England soon afterwards profited by the improvement. Before the end of the century, Lee of Cambridge invented the stocking loom, which imitated the texture of the knit stockings manufactured in Spain about 1550. Mills for drawing wire and slitting iron were first erected about the same period, and Birmingham and Sheffield were, even then, celebrated for their manufactures, and for the germ of that powerful machinery which has since astonished the world by its wonderful productions, as well as by the facility and expedition with which they are fabricated.

Mathematics. With the revival of Literature a new science was introduced into Europe from Arabia, of a name and character unknown to the Geometers of antiquity. The feeble attempts of the early improvers of *Algebra*, gave no indications, however, of that splendid career which it was destined to run in the hands of the modern mathematicians. Even the towering genius of the Greeks, during the most flourishing periods of their philosophy and science, was unable to rise to the invention of the Analytic Art. Diophantus of Alexandria, who is believed to have flourished a few years before Hipparchus, had, no doubt, composed a curious treatise consisting of thirteen books of Arithmetical questions, many of which are of considerable difficulty; but the instrument which he employs, being chiefly an abridgement of ordinary language, is comparatively weak and imperfect, though he manages it with great address and skill. Leonardo, a wealthy merchant of Pisa, who made frequent commercial adventures to the East, was the first who made the science of Algebra known in Europe, about the commencement of the thirteenth century. This science is supposed to have been originally carried from India into Arabia, by Mahomet Ben Musa of Chorasan, about the same time that Gerbert the Monk, otherwise called Sylvester II. first introduced the Arabic system of notation among his countrymen in the Low Countries. The first printed treatise on Algebra, was that of Lucas Pacioli, or de Burgo, published in 1494. The characters employed in this work, as well as in that of Leonardo, which existed only in manuscript, consist of mere verbal abbreviations; thus, showing that this science was in its early state, merely a system of short-hand applied to the solution of arithmetical problems; yet to this simple invention are we indebted for one of the most powerful weapons of modern discovery. The work of Diophantus was given to the world by Xylander in 1575. The utmost extent to which these early writers on Algebra had arrived, was the solution of Quadratic Equations; and even in India, the father-land of the science, their knowledge seems still to be circumscribed within such narrow limits.

Cardan and Tartalea. Italy, which had been the scene of so many revolutions for ages, was now destined to behold the peaceful warfare of Science. The discovery of the method of solving Cubic Equations, the joint result of the labours and skill of Scipio Ferreo, Tartalea and Cardan, forms a remarkable era in the history of the Analytic Art. Ferreo, who was Professor of Mathematics at Bologna, had, in 1508, found out a rule for the resolution of one of the cases of these Equations, which, after the manner of mathematicians in those days, one of his scholars obscurely communicated in a challenge to Tartalea of Brescia, to try their strength in the new art. The genius of Tartalea, being thus called into action, soon enabled him to discover the method of solution and to extend it to more intricate cases. The report of this discovery excited in Cardan of Milan, who was well skilled in the knowledge of Algebra as it was then practised, the most ardent and lively curiosity, and he ceased not to importune Tartalea with the most earnest solicitations, till he had extorted the rules from the latter, under the most solemn promises and oaths of secrecy. Cardan soon discovered their demonstrations, and having extended this important discovery to all kinds of cubic equations, he published the method to the world in 1545, as his own, without any regard to his oaths, or acknowledgment of the man to whom he was so much indebted. However unfair such conduct might be to his contemporaries, he conferred a permanent benefit on Science, and marked a point in the progress of Algebraic investigation, with respect to the solution of equations, beyond which all the efforts of succeeding Analysts have scarcely been able to reach. The irreducible case which falls under Cardan's rule, has baffled all the mathematicians of Europe since that period, and may safely be ranked, along with the quadrature of the circle and the trisection of an angle, among the problems which are doomed to exercise human skill and ingenuity in vain.

Astronomy was the first of the sciences that was regenerated on the revival of learning. It had always been cultivated, even during the middle ages, from its supposed connection with the absurd and illusive science of Astrology, which, as well as alchemy and magic, was prosecuted with great assiduity in those periods of ignorance. Even in the thirteenth and fourteenth centuries, professors of Astrology were appointed in the Universities of Italy, to instruct their pupils in the nature of the influence of the stars. Previous to this period, astronomical observations of an authentic date, about 1278, had been made in China by Cocheouking, whereby the obliquity of the ecliptic was very accurately made known. The Persians had likewise made great progress in astronomy, and Ulugh Beigh, in his capital of Samarcand, in 1437, employed very elaborate instruments in the investigations of this sublime science. *Alphonso*, King of Castile, who flourished about the middle of the thirteenth century, was the first who dared to question the system of the world, which had descended from antiquity, hallowed by the venerable names of Aristotle and Ptolemy. The bold saying of this prince has been justly taxed with impiety, and though on that account deeply liable to censure, it exhibits, in a strong point of view, the difficulty which an accurate investigation of nature always presents to the reconciliation of facts with preconceived theories. Milton, whose learning and genius drew illustrations from every branch of human knowledge, has alluded to this ancient and complicated system in his divine poem;

> " Hereafter, when they come to model Heaven
> And calculate the stars; how they will wield
> The mighty frame; how build, unbuild, contrive
> To *save appearances*; how gird the sphere
> With centrick and eccentrick scribbled o'er
> Cycle and epicycle, orb in orb."

Copernicus. Several valuable improvements had been introduced into astronomical calculations by Purbach and Regiomontanus, two eminent mathematicians of the fifteenth century, when Copernicus arose like a meteor in the midnight sky, and unfolded to the gaze of man the true system of the world. This illustrious astronomer, who was born at Thorn, in Prussia, in 1473, stands at the head of that able phalanx of discoverers, in modern times, who, bursting the fetters of prejudice and authority, discarded every opinion in philosophy not founded on experience and observation. Dissatisfied with the complicated hypotheses of the Ptolemaic system, he examined the works of the ancients now laid open to Europe, in quest of more satisfactory opinions. It is supposed that he borrowed his ideas of the true system from the allegorical notions of the Pythagoreans, and that he applied them to the numerous observations which had been accumulated by the diligence of astronomers. Finding them all in perfect conformity with his theory, he quickly threw aside the Ptolemean epicycles, and in those remarkable phenomena, beheld nothing but the necessary consequences of the combination of the motions of the earth and planets round the sun; thus, he was enabled to calculate the relative distances of the planets from the sun, which, till then, had remained unknown. The marks of that beautiful simplicity which pervades all the works of nature, being impressed on this system, carried with it the most convincing evidence of its truth. The publication of the work which contained the explanation of the doctrines of Copernicus, took place in 1543, only a few days before his death; and, what is remarkable, was earnestly solicited by a Cardinal; while the book itself was dedicated to the Pope. In this work, he promulgated the opinion of the earth's motion with great caution, as if he had been gifted with a presentiment of the opposition it should one day experience. This system, at first, attracted so little attention, that it was rejected by most of the learned, and it lay, as it were, smouldering in secret for half a century, till, by the exertions and the fame of Galileo, it was kindled into so bright a flame, as to consume the philosophy of Aristotle, alarm the hierarchy of Rome, and threaten the destruction of every opinion that had descended from antiquity.

Tycho Brahé. Another eminent astronomer flourished towards the end of the sixteenth century, in the small isle of Huen, at the entrance of the Baltic Sea. There the noble Dane Tycho Brahé erected his famous observatory of Uraniburg, and enriched Astronomy by observations equally celebrated for their number and their accuracy. He employed instruments which were not only the most perfect hitherto constructed, but introduced the valuable improvement of detecting and rectifying their errors by actual observation. He formed a new catalogue of the stars amounting to 777, and discovered almost all the irregularities of the moon's motion, that were known previous to the theory of universal gravitation. He clearly pointed out the nature of atmospherical refraction, and even contrived an instrument for rendering it visible. His theory of comets which was just, and his observations on the appearance of the new star in 1572, gave a severe blow to the physics of Aristotle which were now beginning to fade before the splendour of modern discovery. Unfortunately, he was deterred, by religious scruples, from adopting the true system of the world unfolded by Copernicus, and thus, by one retrograde step, lost the glory of giving the finishing touch to that noble column in the temple of science, which his own invaluable labours had reared.

Kepler. Modern times can scarcely present a name more illustrious than that of Kepler. Born in 1571, at Wiel in Germany, and living at a period when the scholastic philosophy was yet in vogue, and the authority of Aristotle still maintained its ascendancy, he soon rose above the errors of his day by the force of his superior genius. He commenced his splendid career by adopting the planetary system of Copernicus, which was then becoming popular. He corrected the law of refraction, and applied the principles of Optics to Astronomy. In his works he tells us there were three things of which he anxiously sought to discover the reason, from his early youth; namely, why the planets were six in number; why they performed their revolutions in orbits of the dimensions ascribed to them by Copernicus; and what were the laws of these revolutions. In the true spirit of the ancient Pythagoreans, he endeavoured, at first, to account for these phenomena by the properties of number and figure, and by the analogy and harmony of nature. The candour with which he acknowledges his obligations to Tycho Brahé, whose pupil and assistant he afterwards became, for properly directing him in his investigations, cannot be too much admired. Succeeding to his illustrious master in his appointments at Prague, under the emperor Rudolph, he enjoyed the enviable title of "Imperial Mathematician;" there his bold and exuberant imagination, working on the register of the accurate observations of the Danish astronomer, and aided by the most persevering industry and intense labour in calculating and combining them for the space of 17 years, at last drew aside the hitherto impenetrable veil, and disclosed to view those eternal laws which govern the revolutions of the heavenly bodies. Kepler, besides those three remarkable laws which are generally distinguished by his name, made several other important additions to Astronomy. He corrected the errors of Copernicus respecting the parallelism of the earth's axis, and before his death, which happened in 1630, had the satisfaction of applying his immortal theory of the planetary motions to the satellites of the planet Jupiter. When we consider the nature of the discoveries of Kepler, as being elevated far above the observation of ordinary men,—when we reflect on the deep enthusiasm that dwelt in his bosom even from his youth, on subjects of such a profound and exalted nature, and so far removed from what usually interests the human race,—and, above all, when we contemplate that patient, unwearied, and unremitting spirit of perseverance which bore him through the most lengthened and perplexing calculations and hypotheses, at a period when the use of logarithms was yet unknown, and the rules of philosophizing were still in an embryo state,—we must award the homage of our greatest respect and profoundest admiration, to his brilliant and indefatigable genius.

Galileo. The noble army of scientific men was now rapidly increasing. Galileo, the illustrious cotemporary and rival of Kepler, was born at Pisa, in 1564. The news of the happy discovery of the telescope in Holland, having reached Galileo in 1609, he soon re-invented that instrument for himself, and had the singular felicity of being the first to point the wondrous tube to heaven, to observe the varying phases of the planets, and to discover the immutable order and harmony of new worlds. The sensations which must have been communicated, may be more easily conceived than expressed, when first

> "the moon, whose orb
> Through optick glass, the Tuscan artist views
> At evening from the top of Fesolé,
> Or in Valdarno, to descry new lands,
> Rivers, or mountains in her spotty globe."

The earth and the planets were now proved to be similar bodies, and the ancient systems of the universe annihilated by this single instrument, were replaced by a system more suitable to the simplicity and magnificence of nature. When the same illustrious philosopher turned his telescope to the fixed stars, his surprise at finding their magnitude diminished was only surpassed by the splendour of the glorious spectacle laid open to his admiring view; he then discovered that the Almighty had filled infinite space with innumerable instances of his creative power invisible to the naked eye,

> "And sow'd with stars the heavens, thick as a field."

Such extended conceptions of the mechanism of the universe, could not fail to delight and astonish mankind, and to raise their minds far above the grovelling and limited ideas formerly entertained of the power, the wisdom, and the goodness of the Great Author of Nature. The next discovery of the Italian Philosopher was that of the satellites of Jupiter, which he announced in his "Nuncius Sidereus," or "Starry Messenger," under the title of the Medicean stars. His telescope was not sufficiently powerful to detect the remarkable phenomena of the ring of Saturn, though he pointed out those uncommon appearances which led to its discovery. The beautiful crescent of Venus, and the gibbous figure of Mars, enabled him to give the most convincing demonstration that had yet been adduced of the Copernican system, and to verify the sagacious conjecture of its author, that, if the sense of sight were sufficiently powerful, we should see Mercury and Venus exhibiting phases like those of the moon. The singular and still unexplained phenomenon of the dark spots on the surface of the sun, next attracted the attention of Galileo, and enabled him to ascertain the curious fact of the rotation of that luminary on its own axis. So many shining discoveries threw a halo of renown around the name of the Italian philosopher, and produced a host of enemies to whose machinations, and interest with a corrupt and debased church, he very nigh fell a martyr. Instead of meeting with the admiration and gratitude of the learned, as in our days, he was viewed with jealousy and alarm as an obstinate heretic, and innovator. In proportion to the ability which he displayed, and the success with which the promulgation of his doctrines was crowned, so did the unrelenting rancour of superstitious bigotry pursue the venerable genius who had overthrown the idols of antiquity, opened up a new path to knowledge, and almost doubled the faculties of the race. Arraigned before the tribunal of the Inquisition—the most infamous engine of power ever suggested by infernal agents—a council of seven Cardinals pronounced a sentence which, for the sake of those who imagine that wisdom and power are synonymous terms, ought never to be forgotten: " That to maintain the sun to be immoveable and without local motion, in the centre of the world, is an absurd proposition, false in philosophy, heretical in religion, and contrary to the testimony of scripture. That it is equally absurd and false in philosophy to assert that the earth is not immoveable in the centre of the world, and considered theologically, equally erroneous and heretical." In 1663, Galileo, at the age of 70 years, was again brought before the Inquisition, forced solemnly to disavow his belief in the motion of the earth, and condemned to perpetual imprisonment. The very means, however, which the church of Rome took to suppress this heresy, tended only to fan the flame which science had kindled; and, while we look back with regret on the persecution of that venerable sage, we ought to glory in the emancipation of the human mind from that spiritual thraldom which was alike the bane of true religion and sound philosophy.

Fine Arts. The day-spring of knowledge which had thus risen on the human race, had also a regenerating and enlivening influence on the progress of the Fine Arts. Italy, during the fourteenth and fifteenth centuries, produced those inimitable masters of Painting, whose fame rivals that of the ancient Grecian artists, even when in the full tide of their glory. *Leonardo da Vinci,* who was born at Florence in 1452, was the first who gave a prelude of that degree of excellence which was afterwards to be attained in this divine art, and which brought the achievements of the moderns in comparison with those of the age of Pericles. He was the most accomplished man of his age, and merits the esteem of posterity for the universality of his talents, which were successfully applied, not only to poetry and painting, but also to architecture, mathematics, and mechanics. The transcendent genius of *Michael Angelo,* his contemporary and illustrious rival, stamped the character of the Florentine school with grandeur and sublimity. The fame of Leonardo excited in his breast that flame of emulation, which set fire to a train of achievements in the arts more brilliant than had ever before illuminated Italy. The appearance of a new competitor in the field, the immortal *Raphael,* who was born at Urbino in 1483, gave an impulse to mind and a glory to art, which succeeding ages are content to admire without the hope of ever reaching, much less surpassing, by any after effort of creative skill. Angelo, who had striven for the palm of superiority with Da Vinci, was doomed, in his turn, to be outshone by the more splendid genius of Raphael. Yet the history of human ingenuity does not furnish a more miraculous example of undaunted perseverance than that of Angelo in the fresco painting of the Deluge, the very first trial of his skill with that great master of the Roman school. The most stupendous production of his genius was the Last Judgment, which occupied eight years, and contained three hundred figures, executed with such ease, majesty, and grandeur, as not only to strike despair into the minds of his contemporaries, but into those of almost every succeeding generation of artists. The rising renown of Raphael threw the lustre of Angelo's fame partially into the shade. Such was the peculiar modesty and candour of this young artist, however, that he expressed his gratitude to Providence, for having been destined to live at the same period with that eminent man.

The works of Angelo proved a rich mine to the aspiring Roman, and were to him what the immortal poem of Homer had been to the Mantuan bard. The muscular forms, the bold outline, and the energetic attitudes of the Florentine artist, were softened and harmonized in the elegant and graceful productions of the pencil of Raphael. Though the career of this illustrious genius was short, it was splendid; and the fertile age of Leo X. beheld none whose works could equal his in touching simplicity and grace. His celebrated " Cartoons," are well known, and have been often described. The " Transfiguration," a picture of immortal Touch, terminated the labours of this divine artist. None of the immediate followers of these great masters in Italy could equal their productions; and, indeed, a manifest declension in the Fine Arts speedily succeeded. Other masters arose in various places on the continent, and produced works of considerable merit, but the grandeur and natural simplicity of the Italian artists were gone. The Venetian school could boast of their Giorgione and Titian; and the Lombard school, of Corregio and the Caraccis, the former of whom is deemed worthy of being classed in the same rank with Angelo and Raphael. The French school had their Poussin and Lorraine; and the Flemish their Rubens, Vandyke, and Rembrandt,—the latter a genius of extraordinary skill and romantic originality. Such a brilliant galaxy of talent, which had thus succeeded the age of erudition, showed that man possessed powers capable of the most astonishing exertions if properly directed, and that the principle of emulation is the fruitful parent of all that is great and ennobling in Science, as well as all that is elegant and beautiful in

Art. The human mind, has, however, in all ages, required the gigantic efforts of some master spirit to set it free from the trammels of authority, to overthrow the inveteracy of antiquated opinion, and to enable the race to explore with a fearless eye the wide fields of knowledge and of nature.

Mechanics. From the time of Archimedes till the era of Galileo's discoveries, comparatively little progress had been made in Mechanical science. *Guido Ubaldi*, an Italian, in his treatise published in 1577, was the first who attempted to extend the theory beyond the investigations of the ancients. He simplified several of the mechanical powers, and wrote a valuable commentary on the works of Archimedes. *Stevinus*, a Dutch engineer, was the first, however, who passed the limits of mechanical knowledge possessed by the philosophers of the Alexandrian school, and their commentators. He accurately ascertained the force necessary to sustain a body on an inclined plane, and thus discovered the solution of that particular case of the composition of forces, by which the equilibrium of any three forces is determined. His demonstration is extremely ingenious, and remarkable, as being the first solution of a problem which had stood as a barrier in the way of mechanical discovery for ages. He detected the important law in Hydrostatics, that the pressure of fluids is simply in proportion to their depth. As Kepler has been elegantly styled the forerunner of Newton in his Astronomical discoveries, so may this appellation be awarded to Galileo with regard to those in Physical Science. In his treatise *della Scienza Mecanica*, published in 1592, he unfolded the theory of the Mechanical Powers, and developed that important mechanical principle afterwards denominated the principle of *Virtual Velocities.* He extended his investigations both to statical and dynamical questions relative to the doctrine forces, and showed that if the effect of a force be estimated by the weight which it can raise in a given time, no mechanical contrivance can ever increase that effect. Important as these discoveries were, they were eclipsed by others of a more remarkable nature. The theory of variable motion, wholly unknown to the ancients, is due to his penetrating genius. He discovered the law of the acceleration of falling bodies by the action of gravity, both vertically and along inclined planes, and established it both by experiment and mathematical demonstration. It was during his professorship in the university of Pisa, that he made those experiments which laid the foundation of his fame. Having attacked the fundamental axiom of the Aristotelian philosophy, that the velocities of falling bodies were proportional to their weights, he publicly demonstrated its fallacy by letting fall heavy bodies from the top of the church in that city. The experiment attracted crowds of spectators, and the popularity which he thus acquired, drew upon him those persecutions with which the prejudice and jealousy of his enemies continued to harass and afflict this great philosopher through life, and which may be justly esteemed as the only equivalent for the praise of the liberal and enlightened, that an ignorant and bigotted age can bestow. The vibrations of the lamps in the cathedral having attracted the attention of Galileo, he was led, by the train of reasoning which they suggested, to the discovery of the *isochronism* of pendulums, and other properties of pendulous bodies, which have proved so important in Mechanics.

To ordinary observers, indeed, the swinging of a lamp or the falling of an apple, would seem a matter of the most common and trivial occurrence; but to those who are gifted with the "afflatus divinus" of science, such a simple phenomenon often appears pregnant with those sublime principles that are concealed in the womb of nature, and are only considered as simple and obvious after they have been discovered. Hence the truth of the remark, that it is one of the prerogatives of genius to find the highest value in things which ordinary men are trampling under their feet. The true path of a body when thrown obliquely through the air was first demonstrated by Galileo to be a *parabola*, and on this principle he founded his beautiful "Theory of Projectiles," a step of the highest importance to physical science, as it included, in its full extent, the doctrine of the composition of motion. The vibrations of the pendulum suggested to him the means of accurately measuring time by its application to the clock, which he concluded might be employed to find the longitude by means of observations on the satellites of Jupiter. The discoveries of the Florentine philosopher were wonderful indeed for the age in which he lived. Considering the state of knowledge at that period, they required and found in him a depth of philosophical skill, an acuteness of mathematical research, and a comprehensive grasp of mind, of which we shall vainly attempt to form any conception, without retracing the march of genius in his own luminous and elegant exposition of the steps by which he was conducted to those simple but sublime truths, which formed such a noble acquisition to the territories of the kingdom of Science.

Logarithms. The beginning of the seventeenth century was distinguished by one of the most valuable improvements in Mathematical science that ever shone in the history of human invention. An important step had been made in Arithmetic by Stevinus, who introduced the use of decimal fractions in 1590, the notation of which was soon afterwards so much improved by *Napier* as to retain its form to the present day. This highly favoured genius, who was born in 1550, at Merchistoun in Scotland, had early turned his attention to the discovery of a method of shortening those laborious calculations, which the accuracy of astronomical observation and the improvements in trigonometry required. The rapidity with which the progress of discovery was extending the boundaries of Science had rendered such calculations extremely irksome to the ardent minds of the mathematicians and astronomers of Europe. The freshness of Napier's invention, therefore, burst upon them at once, like the relief which the sudden appearance of the sun through the clouds, brings to mariners in the midst of a storm. In 1614, he published his "Canon Mirificus Logarithmorum," at Edinburgh; and philosophers seeing their difficulties vanish before this wonderful invention, received it with universal applause. The idea of employing the terms of an arithmetical series to discover those of a geometrical series, which formed the basis of this immortal work, had once occurred to Archimedes, but for want of a simpler system of notation, it had never been farther pursued; the tide of his ideas had, in fact, soon after flowed beyond it, and in the long series of ages that succeeded, no genius, less lofty than his, arose to complete the discovery, till the torch of Science again illumed the world. The great merit which the immortal Napier had in this achievement, is owing to the state of Science at the period in which he lived. Algebra had still to receive many of its finest improvements, and though Geometry was advancing with rapid strides, the doctrine of Fluxions was yet unknown. The genius of this great inventor appears to have leaped over many intervening barriers which, to less powerful minds, would have presented insuperable difficulties, and, seizing upon the discoveries of a future age, to have compressed them into the single principle from whence his invention emanated. The idea of considering all numbers as powers of a given number assumed as a base, was an expansion of thought which carried him over a century of discovery, and placed him by the side of the inventor of the new Calculus. Logarithms, indeed, contributed in a very high degree to the subsequent progress of science; and, in the hands of modern mathematicians, proved an engine of no ordinary power. In conjunction with the various branches of Analytical science, it has become a gigantic instrument of investigation and discovery; and, like the fabled wand of the magician, has enabled the philosopher to penetrate into the mysteries of nature.

Baconian Philosophy. The march of the human understanding had now surpassed its progress in every former age. Even the brightest periods of antiquity were thrown into the shade by the splendour of modern discovery. The mind of man was on the eve of some mighty achievement, when Bacon arose and bore away the palm of triumph. To secure to the human race, the acquisitions it had won, and to prevent it for ever from returning to that state of intellectual darkness and degradation from which it had so gloriously emerged, it was necessary to ascertain and to fix the laws of philosophical investigation, and to compress them into one grand and ruling principle,

> " that might direct
> Our knowledge, and the scale of nature set
> From centre to circumference."

Such a gigantic effort required the hand of some master genius; and philosophy, at last, taking her flight to our favoured isle, delegated her power to Lord Bacon. Born at London, in 1560, he had been early dissatisfied with the Aristotelian philosophy, still taught in the schools, and soon turned his powerful mind to the contemplation of the state of human knowledge, to the investigation of the causes of its imperfections, and to the formation of plans for its improvement. He clearly saw the vagueness and uncertainty of the physical speculations which at that period still prevailed among philosophers, and he beheld, with the penetrating eye of genius, the want of a connecting link between the sciences and the arts. He perceived the necessity of investigating nature not only by careful observation but by accurate experiment, before man could venture to generalize facts, and found a solid body of knowledge on such an inductive process. He saw, that to discover the Protean forms of material objects, required both the caution and the intrepidity of the experimental philosopher; and that, if he would seize the predominant agent, and unfold the different principles of action, he must press Nature into a corner, and compel the unwilling captive to reveal her secrets. Examples of the true method of investigating nature had been afforded by the discoveries of his contemporaries. Dr. Gilbert of Colchester, particularly, in his treatise, " De Magnete," in which he established terrestrial Magnetism, and laid the foundation of electricity, had furnished an admirable model of philosophical analysis; the various facts were there reduced to a few leading principles, and occasional gleams were thrown on other branches of science. The early germ of the Inductive philosophy, however, is contained in the remarkable advice given by Tycho Brahé to Kepler, on receiving a copy of his " Mysterium Cosmographicum ":—" Argumentum literarum Brachei," says Kepler, " hoc erat, *uti suspensis speculationibus a priori descendentibus, animum potius ad observationes, quas simul offerebat, considerandas adjicerem. Inque iis primo gradu facto, postea demum ad causas ascenderem.*" This valuable advice, which is not surpassed by any of the Aphorisms of Lord Bacon, may be said to comprehend the sum and substance of the *Novum Organum.* From this luminous view of the true spirit of philosophy, so admirably illustrated by the after discoveries of Kepler, Galileo, and others, how easy was the transition to the first sentence of that immortal work! " *Homo naturæ minister et interpres tantum facit et intelligit quantum de naturæ ordine re vel mente observaverit, nec amplius scit aut potest.*" The reformation of religion, in addition to the general progress of the arts and sciences, contributed in no small degree to emancipate the mind of man from the errors of ancient system, and to pave the way for the labours of Bacon. In the " Novum Organum," published in 1620, he divided the causes of error into four heads, which he figuratively denominated the Idols of the Tribe, the Den, the Forum, and the Theatre. The first, are those which are founded in human nature; the second, in the character of the individual; the third, in the intercourse of society; and the fourth, in the systems of the different schools of philosophy. He next arranged the different modes of investigation founded on an induction from facts, under twenty-seven different species; fifteen of which are addressed to the understanding; five serve to correct or inform the senses; and seven to direct the hand in raising the superstructure of art on the foundation of science. The ingenuity and ability displayed by Lord Bacon in thus directing the human intellect in its researches after truth, surpass all praise. The compass of that mind which formed the plan, traced the outline and ramifications of experimental inquiry in branches of science yet to be discovered, must be an object of admiration to all future ages; and before another genius comparable to his can be found, the human race must return to that state of ignorance from which they were so happily emancipated.

Cartesian Philosophy. Various important discoveries succeeded the era of the Inductive philosophy. *Torricelli,* the friend and pupil of Galileo, laid the foundation of Hydraulics by proving that water issues from a hole in the side or bottom of a vessel, with the velocity which a body would acquire by falling from the level of its surface to the level of the orifice. He discovered the reason why water cannot be raised, in pumps, higher than 33 feet—which had been left unexplained by his master—and demonstrated the existence of Atmospheric pressure, by his celebrated experiment of the suspension of mercury in the barometer. *Pascal* suggested, in farther confirmation of this doctrine, the experiment whereby the diminution of that pressure was made known, by carrying the barometer to the top of the Puy de Dome, and thus affording an accurate method of determining the altitudes of mountains. *Otto Guericke,* in Germany, about 1654, completely overthrew all the objections of the Aristotelian philosophers to the pressure of the atmosphere, by the invention of the air-pump, which was afterwards improved by Mr. Boyle. The doctrines of Aristotle, which had been frequently attacked in detail, were now destined to be completely demolished by the penetrating genius of Descartes. This original and inventive philosopher, who flourished about forty years later than Bacon, appears to have been unacquainted with his works. He was equally dissatisfied with the ancient philosophy, and soaring above the influence of prejudice, was hurried away by the ambition of erecting a system of his own. Assuming no other data than matter and motion, he proposed to explain *a priori* the structure and constitution of the universe. Instead of proceeding from the effect to the cause, he reversed the order of the Inductive philosophy, and attempted to proceed from the cause to the effect. The ancients had imagined a *primum mobile,* or kind of homocentric orbs, to account for the celestial motions; Kepler, in the liveliness of his fancy, had conjectured a kind of *animation* and *organic structure;* and Descartes introduced a *plenum,* and *endless vortices,* limiting and circumscribing one another. Absurd as his system of philosophy was, and as ill-calculated to explain the phenomena of nature as any of the former, it maintained its ascendancy over the continent, under various modifications, for the space of nearly a century. In as far as the Cartesian system served to explode the wrangling of the schools, it may be said to have aided the progress of science; but containing in itself the seeds of its own destruction, it was destined at last to be obliterated by the Newtonian philosophy. The other labours of Descartes form a more permanent monument to his fame.

Algebra and Geometry had been making considerable advances since the period of Cardan and Tartalea. Stiphelius, Recorde, Pelitarius and Bombelli, had made improvements in the notation and rules of Algebra. *Vieta,* in his work published in 1600, first employed the letters of the alphabet to denote the known as well as the unknown quantities, by which important step, the symbolical language of this science first became capable of expressing general truths, and, subsequently, such a powerful instrument of investigation. His treatise on "Angular sections" appears to have been the first application of Algebra to Geometry. The discovery of the genesis of Equations, to which *Girard* had made a near approximation, was completed by *Harriot* in 1631, who brought Algebra almost to the perfect form in which it exists at the present day. It was thus prepared for the important step made by *Descartes,* which constitutes a remarkable era in the history of the Mathematical sciences. This philosopher, in his Geometry, published in 1637, showed the application of the Algebraical Analysis to the investigation of the nature and properties of Curves, and first introduced the notion of variable quantity. He solved the curious and difficult problem of the *locus ad quatuor rectas,* in a variety of cases, and invented a method of drawing tangents to curves, in which he was rivalled by *Fermat.* This important branch of analysis was afterwards improved by Roberval, Barrow, and Newton, who was finally led, by his investigations on this subject, to the invention of the method of Fluxions.

The New Calculus. The Mathematical sciences began now to share in the general progress of improvement, which the ferment of discovery had awakened in the mind of man. The ancient method of "Exhaustions," which had been brought to such a degree of perfection by Archimedes, was found to be too cumbrous an instrument for modern investigations. Accordingly, *Cavalieri,* who was born at Milan in 1598, had the good fortune to make the first step in the direct line to the new Calculus. Both Kepler and Galileo had introduced the idea of infinitely great and infinitely small quantities into their geometrical discussions, but Cavalieri, who was a more profound mathematician than either, took up the subject in a regular and systematic form, in his work on "Indivisibles," published in 1635. By this method he arrived at the quadrature of numerous areas, and the cubature of many solids, which surpassed the power of the ancient Geometry, and discovered several new and beautiful theorems. The properties of the Cycloid were unfolded by the same means, and particularly attracted the attention of Torricelli, Roberval, Wren, Wallis, and Huygens. The next important step was made by *Wallis* in his "Arithmetic of Infinites," published in 1600. He effected the quadrature of all curves, where the value of one of the coordinates could be expressed in terms of the other by means of integral and positive indices; but he partially failed, in attempting to obtain the quadrature of the circle, from inability to express the values of those co-ordinates which involved fractional or negative exponents. The remarkable results which such speculations produced, had excited the curiosity of mathematicians both in England and on the Continent. The idea of infinite quantity, after being made the subject of reasoning and calculation, led to conclusions from which, as if by magic, that idea had wholly disappeared, and left the calculator in possession of valuable propositions involving no magnitudes but such as could be readily exhibited.

Newton. The star of genius which had been rising with majestic splendour in the hemisphere of science, at last reached its zenith above our favoured country. Over the birth-place of Newton it shone forth with unclouded lustre, and the beams of its meridian glory were destined to illuminate his path. The invention of the New Calculus, the discovery of the Composition of Light, and of the Principle of Universal Gravitation, all within a period of about twenty years, were a series of more remarkable discoveries than ever fell to the lot of a single individual; and they have encircled the name of the British philosopher with a never-ending fame. Taking up the consideration of the doctrine of "Infinites" at the point where Wallis had failed, he extended it to the case of fractional indices, and thus found the quadrature of the circle and innumerable other curves by the method of infinite series. These investigations first led to the discovery of the Binomial Theorem, and afterwards to the invention of Fluxions in 1666. His treatise on the "Quadrature of Curves" was published in 1704, more than twenty-eight years after it was written. In 1684, *Leibnitz,* a German philosopher, published an account of his "Differential Calculus" in the *Acta Eruditorum,* an invention so entirely the same as that of Newton, as to differ only in the notation. *John and James Bernouilli,* two eminent mathematicians, uniting their talents to those of Leibnitz, spread this new Calculus rapidly over the Continent, by the solution of many interesting and difficult problems which Geometry had hitherto been unable to solve, or which had been suggested by the new invention itself. In a paper on the line of *swiftest descent,* presented by De Duillier to the Royal Society in 1699, the author remarked that Newton was the first inventor of the New Calculus, and insinuated that Leibnitz had borrowed the invention. This remark lighted up a flame which a whole century was scarcely sufficient to extinguish. A war of problems was now declared in the republic of science, between the English and the Continental mathematicians, which was carried on with much asperity on both sides, though the inventors themselves, especially Newton, took little or no share in the disputes. The English being at that period less skilful in the new Analysis than their opponents, were frequently worsted, and it was only when Newton himself condescended to answer their problems, that a victory was gained.

Taylor. A problem respecting the *Brachystochrone,* or line of swiftest descent, proposed in 1697, as a trial of skill between the contending parties, was resolved only by the most distinguished mathematicians —Newton, Leibnitz, the Bernouillis, and De l'Hospital. Newton's solution appearing in the Philosophical Transactions without a name, drew from John Bernouilli the exclamation, "*Ex ungue leonem!*" The problem of *Orthogonal trajectories,* proposed by Leibnitz in 1716, as a defiance to the English mathematicians, was solved by Newton within a few hours after he received it, on his return from the Mint, fatigued with the business of the day. *Brook Taylor,* one of the ablest geometers of that period, published his "Method of Increments" in 1715, and involved himself deeply in this war of science, though with more success than the unfortunate Keill. A single analytical formula in his treatise, conferred on him more celebrity than the most voluminous works are generally found to bestow. If any one proposition could be said to comprehend in itself a whole science, it was the *Taylorian Theorem;* for from it almost all the truths and results of the New Calculus might be deduced, and by its intrinsic merit that science was speedily established all over Europe.

Optics. The knowledge of Optics which existed previous to the invention of the telescope, was too inconsiderable to form a separate body of science. An important step was made by *Baptista Porta,* in 1560, who invented the *Camera Obscura.* In 1604, Kepler added to the glory of discovering the true laws of the planetary system that of first analyzing the whole scheme of nature in the structure of the eye. Antonio de Dominis, in 1611, had the good fortune to give the first satisfactory explanation of the phenomenon of the *Rainbow. Snellius,* the first of the moderns who measured a terrestrial degree, discovered the true law of *Refraction,* which was first published by Descartes, in 1637. *Gregory,* in his "Optica Promota," which appeared in 1663, gave the construction of the *Reflecting Telescope. Huygens,* a genius of the highest order, in his "Dioptrics," greatly improved the science by a developement of the practical rules for the construction of telescopes, as well as of the causes of the aberration of spherical lenses and of the theory of single and double refraction. Optical researches had begun to acquire a peculiar interest from the discoveries gradually revealed by the invention of the telescope and microscope, when *Newton* entered the field and made all those achievements his own, for which they had prepared the way. The unexpected delight which he felt when, in the course of his experiments with the glass prism, he beheld the brilliant colouring of the sun's image thrown on the wall opposite the entrant ray, may be easily conceived. The elongation of the *spectrum* by refraction, and its divergence into the seven primitive colours, disclosed to him the loveliest of Nature's wonders, and first

"Untwisted all the shining robe of day."

The decomposition of Light thus effected, made known the texture of the magic garment which the Deity had so kindly spread over the surface of the visible world, and which is figuratively said to envelope his throne with beams of insupportable brightness. The Rainbow, that beautiful emblem of his mercy, which has equally attracted the attention of the peasant and the philosopher by the brilliancy of its colours, naturally presented itself to the analysis suggested by this discovery. Accordingly, Newton completed the explanation of the machinery which nature employs in the construction of this splendid arch, which had been left unfinished by De Dominis and Descartes, and gave an example of one of the happiest applications of theory which Science affords. The optical researches of Newton form the noblest commentary on the philosophy of Bacon; an individual of moderate talent, with the "Novum Organum" in one hand and the "Optics" of Newton in the other, could not fail to become a philosopher. To see the genius who had risen by his discoveries to such an extraordinary elevation above mankind, descending to the fabrication of soap-bubbles, might excite the risible faculties of the ignorant and unthinking; but, in the eye of philosophy, no toy is esteemed despicable, and no occupation frivolous, which can assist in the investigation of truth. The explanation of the law of Refraction, on dynamical principles, is another instance of the sagacity of Newton, in whose hands light became also the means of making important chemical discoveries respecting the internal constitution of bodies. The increase of refracting power in inflammable bodies, led him to the fine conclusion that bodies of this nature enter into the composition both of the diamond and of water,—a truth confirmed by the subsequent discoveries in chemistry. These discoveries, in addition to his elegant speculations on "Fits of easy transmission and reflection," excited, by their brilliancy and novelty, the admiration of his most enlightened contemporaries, and at the same time created a host of opponents both in this country and on the continent. The latter, however, were either soon silenced, or forced to join in his praise. Newton perfected the construction of the Telescope, and concluded his Optics with those remarkable queries which, penetrating into the region of future discovery, and soaring beyond the limits of poetical fancy, with those of probability still in view, enabled him to alight safe on the *terra incognita sed firma* of philosophic truth.

Physics. The establishment of Academies or Philosophical Societies, about the middle of the seventeenth century, now contributed greatly to the progress of physical science. The Florentine Academicians, who set the first example in 1651, greatly extended our knowledge of nature, and were followed by the Royal Society of London, which was founded in 1662, and the Royal Academy of Sciences at Paris, which was established in 1666, under the enlightened administration of Colbert. The foundation of Observatories, which apparently served only to carry the views of man beyond the boundaries of the world, proved of the greatest advantage to Navigation, and consequently of Commerce and the arts of life. The observatory at Paris was founded in 1667, and that at Greenwich in 1675. About the era of these establishments, Astronomy was enriched by some of its most brilliant discoveries. *Gassendi,* in 1631, first observed the transit of Mercury over the disk of the sun, which had been predicted by Kepler, and *Horrox,* in 1639, first observed that of Venus. *Huygens,* the great successor of Galileo, about this period acquired, by his discoveries, a degree of fame which was only eclipsed by that of Newton. He improved the telescope, and was the first who explained the beautiful phenomenon of the ring of Saturn, which had baffled Galileo. He discovered one of the satellites of Jupiter, other three being afterwards added by Cassini. He was the first who applied the pendulum to clocks, and showed its utility in astronomy. The laws of the collision of bodies, which had been mistaken by Descartes, were discovered and explained by Wallis, Wren, and Huygens, about 1669. The improvements which the latter philosopher introduced into the doctrine of pendulums were of a remarkably beautiful nature, and constituted the most difficult mechanical inquiries previous to the invention of the new Calculus. The theory of central forces unfolded by Huygens, forms a brilliant link in that noble chain of discovery which led Newton to the explanation of the great phenomena of the universe. This immortal genius laid the top-stone of his fame by the publication of his *Principia* in 1687, an era for ever memorable in the annals of Science. This work, which confers more glory on its author, than the achievements of an Alexander or a Cæsar, compressed the beautiful laws of Kepler into the single Principle of Attraction, and showed that the law of this force, which was the common bond of union in the planetary system, varied inversely as the square of the distance. One of the most remarkable results contained in the Principia, was the method of determining the quantities of matter and densities of the planets, investigations so recondite that they seemed the farthest removed beyond the sphere of human knowledge. The principle of universal Gravitation was found to afford the only solution of the irregularities of the moon's motion that were known, and of all those discovered afterwards which related not only to that body, but to other bodies in the system. The same penetration which enabled its author to range through the celestial spaces, taught him to define the true figure of the earth, and to calculate the tides of the ocean. The cause of the precession of the equinoxes, the true form of the orbits of comets, the properties of water and air, the motion of currents and the propagation of sound, were all brought under the dominion of this amazing genius. Newton had the singular good fortune to enjoy during his life, and in his native country as well as abroad, that high respect and admiration to which he was entitled by his sublime researches and discoveries. He was successively elected Parliamentary representative of the University of Cambridge, Master of the Mint, and President of the Royal Society. Since his death, which happened in 1727, at the advanced age of 80 years, eulogy has been exhausted in tributes to his memory, and Europe has been filled with rivals in his praise. In extent and refinement of mathematical skill, he had no compeer, and the testimony of recent writers, of the highest eminence declares, that he must have discovered certain improvements in the higher analysis unknown even to Euler, and to every mathematician before Laplace. In the study of Nature and her laws, and in the investigation of her analogies and resources, he seems to have been inspired, as it were, with wisdom from an invisible source, and to have been enabled, by a kind of prophetic sagacity, to discover many noble truths which were still veiled in the impervious gloom of futurity. To him, therefore, as intellectual representative of the human race, may be justly applied, that fine saying of Suidas, which inspired Bacon with his figurative appellation of man: "Της φυσεος γραμματευς ἠν, τον καλαμον ἀποβρεχων εἰς νουν."

Newtonian Philosophy. The spread of the Newtonian Philosophy was for a few years retarded by the doctrines of Descartes and his followers, but at last their splendid and imposing fabric was sapped to the foundation, and the immortal structure of Newton, founded on the eternal basis of Geometry, raised in its stead. The mensuration of a terrestrial degree within the arctic circle, and another at the equator, between 1736 and 1742, affording a comparison of results conformable to the Newtonian theory of attraction, completed its triumph on the continent, and forced Cassini and others who had opposed its progress, to become converts to the New Philosophy. The discoveries of Cassini in Astronomy, led to another more remarkable for its singularity and minuteness than any that had yet occurred in the progress of that science. This was the *Velocity* with which *light travels* through space, discovered by Olaus Roemer, a Danish astronomer, in 1667, who offered this as the explanation of the periodic inequality in the eclipses of the satellites of Jupiter, proved his conjectures by calculation, and immortalized his name by the discovery. *Cotes*, the friend of Newton, who signalized himself by his discoveries in the new Calculus published in his profound work the Harmonia Mensurarum, cultivated the doctrine of Hydrostatics with great success. *Dr. Halley*, to whose liberality and enthusiasm the world first owed the publication of the Principia of Newton, was a most assiduous and indefatigable observer of nature, and he has laid science under great obligations. The natural history of the atmosphere, of the ocean and of magnetism, can furnish proofs of his skill as a philosopher, and both Navigation and Astronomy were enriched by his labours. He predicted the return of the comet of 1759, ascertained the nature of evaporation on the vast scale of nature in the Mediterranean, and accounted for the origin of fountains and many other natural and meteorological phenomena. In 1701, he published his Variation Chart, so valuable to navigators at that period and for many years afterwards, and gave the first probable theory of that unknown power which causes the Magnetic needle to deviate from the true North. His observations on this subject were indeed the germ of more recent and important discoveries in the history of Magnetism. The Copernican system of the world, which had been so irrefragably established by Newton, was destined to receive another confirmation as remarkable as it was unexpected. The discovery of the *Aberration of the fixed stars*, in 1726, presented the most complete demonstration of the velocity of light and of the motion of the earth in its orbit, which had yet been afforded by the delicacy of modern researches, and placed the name of Dr. Bradley high in the scale of renown. This celebrated astronomer made another discovery no less important than the preceding, namely, the *nutation of the earth's axis*, which completed the explanation of the cause of the precession of the equinoxes, developed in the Celestial Mechanics of the great founder of Physical Astronomy. The philosophy of Newton assumed a more popular form than it possessed in his great work, in the writings of Clarke, Pemberton, Maclaurin and Musschenbroek, and in the lectures of S'Gravesande and Desaguliers, while its more refined investigations were extended and improved by Maclaurin and Simpson in this country, and by Herman, D. Bernouilli, Euler, Clairault, and D'Alembert on the continent. Maclaurin, Bernouilli, and Euler had the honour of sharing with each other the prize proposed by the Academy of Sciences at Paris, in 1740, for the best Essay on the Causes of the Phenomena of the Tides.

Euler, who was born near Basle, in 1707, was one of the greatest mathematicians of which the eighteenth century, so rich in genius, can boast. He invented *Analytical Trigonometry*, a Calculus no less important than that of Newton, not only for its utility in the higher Geometry, but for its beautiful applications in Physical Astronomy. He subjected to the analytical method, which had now left the ancient Geometry at an infinite distance, the theory of rational mechanics, the whole range of physical astronomy, the vibrations of elastic and incompressible fluids, naval architecture and tactics, the doctrine of chances, probabilities, &c. and made such admirable additions, improvements, and inventions, that of him it might be truly said, with respect to these sciences, "nunquam tetigit, quod non ornavit." France, a country so renowned for splendid genius, produced, about this period, two of her most eminent men to divide the conquests of science, which were beginning to shed a glory over the middle of the eighteenth century, unparalleled in the history of human knowledge. *D'Alembert*, who was born in 1717, made an improvement in the Integral Calculus, which doubled its power and extent. This was the invention of the method of *Partial Differences*, which was afterwards improved in form and notation by the great Euler. *Clairault*, born two years later, commenced a career equally splendid by the publication of his treatise on "Curves of Double Curvature," at the early age of sixteen. These three great geometers, than whom there did not exist at that period a more noble triumvirate, had studied in the schools of Newton and Leibnitz, and having greatly improved the methods of their masters, began, nearly about the same time and unknown to each other, to attempt the solution of the famous problem of the *Three Bodies*. The result was the greater perfection of the Lunar Theory, and the subsequent advantage to Navigation. The solution of Euler furnished data for the accurate tables of Tobias Mayer of Gottingen, which were rewarded by the Board of Longitude in England. Euler also constructed a set of accurate tables from his own theory, which were rewarded by the Board of Longitude in France.

Lagrange. Splendid as the achievements of these great mathematicians appear when compared with the efforts of their predecessors, they sink in the scale of invention before the towering ascent of Lagrange. Born at Turin in 1736, he commenced his illustrious career by an addition to the integral calculus, denominated the *Calculus of variations.* Euler, though he stood at the head of mathematical science, with that generosity and nobleness of mind which are always the characteristic of supereminent talents, was the first to hail the appearance of the young mathematician with joy, and to celebrate his fame by pointing out his merits and adopting his method in preference to his own. This is indeed an instance of the intellectual sublime rarely to be met with in the history of the world, while in that of science it stands without a parallel. The publication of the *Mecanique Analytique* constituted an era in the progress of human knowledge, which even the sagacity of Newton could hardly have anticipated. D'Alembert had discovered the mechanical principle which reduced every question respecting the motion of bodies to a case of equilibrium. This principle was extended by Lagrange, who subjected all problems of this description to mathematical computation, by differential equations, whereby their solution was reduced to the integration of such equations. The singularity of this treatise, besides its profundity and excellence, may be remarked. In this treatise there is no reference made to figures, notwithstanding the great number of mechanical problems which are resolved. The resolution of all the forces that act on a point, into three forces acting at right angles to one another, enables the author to express their relations sufficiently distinct, without representing them by a figure, or by any other symbols than those that are algebraic. The perfection of Physical Astronomy was now approaching. The theory of the disturbing forces of the planets had been successfully cultivated by Euler and his compeers. He proved that the change which had been discovered in the obliquity of the ecliptic was periodical. Yet the secular inequalities in the motions of Jupiter and Saturn were not satisfactorily accounted for; geometers began to push their investigations to the extreme, when Lagrange arose on the eve of discovery and effected one of her noblest achievements. Struck with the circumstance that the calculus had always brought out periodical inequalities, he pursued the study of the general question, whether, in the solar system, those inequalities which continually increase or diminish, and consequently affect the mean motion of the planets, can ever be produced by their mutual gravitation. He found that the inequalities produced by the mutual action of the planets, must in effect be all periodical; and that amid all the changes which arise from this cause, two things remain perpetually the same,—the *mean distance,* and the *mean motion* of each planet. Variations occur in the plane of the orbit and in the nature and eccentricity of the ellipse, but never in its greater axis, nor in the time of the entire revolution of the planet. "The discovery of this great principle, which," as Playfair says, "we may consider the bulwark that secures the stability of our system, and excludes all access to confusion and disorder, must render the name of Lagrange for ever memorable in science, and ever revered by those who delight in the contemplation of whatever is excellent and sublime. After Newton's discovery of the elliptic orbits of the planets, Lagrange's discovery of their periodical inequalities is, without doubt, the noblest truth in Physical Astronomy." This immortal genius, whose mathematical skill surpasses eulogy, had the glory of being the first to remove the difficulties which had clouded the entrance to the New Calculus since the period of Newton, and by his invention of the *Theory of Functions,* to place the noble pyramid of science, reared by the labours of genius, on a firm and immoveable basis.

Laplace. By the efforts of the illustrious astronomers Clairault, D'Alembert, Euler, Lagrange, and Laplace, it was found that, at the close of the eighteenth century, there did not remain a single phenomenon in the celestial motions that was not explained on the principle of Universal Gravitation. To complete the theory of Astronomy, and to compress into one system the entire compass of that science and its discoveries during the most brilliant period in the history of the race, required the genius of another Newton, and this was found in the person of *Laplace.* His treatise entitled the *Mecanique Celeste* fulfilled this arduous undertaking, in a manner that does honour to science and to man, and left nothing more to wish for in this department of human knowledge. We deeply regret that our limited space prevents us from doing justice to the transcendent merits of this immortal astronomer, whose honour is, that the "genius of the human race is the only rival of his fame."

In the perusal of a Dictionary of Arts and Sciences, the reader is generally guided by his own taste and inclination, or by the particular line of his professional or other pursuits, without attending much to any didactic plan that may be proposed in an introduction. A scheme of the contents of such a work, however, adapted to a regular method of study, and expanded according to a natural order, may be of great service to those who have never enjoyed the advantages of a systematic education. We have accordingly adopted the following arrangement of the branches of human knowledge from the prospectus of the European Review, and classified under its various heads such portions of this Encylopædia as correspond with the plan, which, though far from being complete, is perhaps as perfect as any that has been proposed.

The Sciences, according to their natural arrangement, comprehend:—the Principles of all things—the Elements which these *principles* originate—the Beings which these *elements* form—the Organs which these *beings* develope—the Wants which these *organs* experience—the Signs which these *wants* excite—the Societies which these *signs* produce—the Countries which these *societies* inhabit—the Earth which these *countries* compose—the Planetary System to which the *earth* belongs.

GENERAL HEADS.	PARTICULAR SUBJECTS.	NAMES OF THE SCIENCES, INCLUDING THE FOLLOWING SUBDIVISIONS.
PRINCIPLES	Matter, Space, Motion	METAPHYSICS, Philosophy.
	Extension, Divisibility, Impenetrability, &c.	PHYSICS, or Natural Philosophy.
	Number, Form, Magnitude	MATHEMATICS, Arithmetic, Geometry, Algebra, Mensuration, &c.
ELEMENTS	Atoms	ATOMOLOGY, Acoustics, Optics, Pneumatics, Doctrines of Heat, Light, Sound, Steam.
	Molecules	CHEMISTRY, Electricity, Galvanism, Magnetism.
	Masses	MECHANICS, Statics, Dynamics, Hydrostatics, Hydrodynamics.
BEINGS	Minerals	MINERALOGY, Crystallography.
	Vegetables	BOTANY.
	Animals	ZOOLOGY, Bee, Conchology, Entomology, Erpetology, Helminthology, Ichthyology, Mammalia, Ophiology.
ORGANS	Forms	PHYSIOGNOMY, Phrenology.
	Structures	ANATOMY, Zootomy, Surgery.
	Actions	PHYSIOLOGY.
WANTS	Clothing	COSTUME.
	Food	GARDENING, Agriculture, Brewing, Dietetics.
	Shelter	ARCHITECTURE.
SIGNS	Speech	LANGUAGE, Philology, Rhetoric. POETRY, Novel, Versification. MUSIC.
	Gesture	GESTURE, Games, Recreations, Sports and Pastimes. SCULPTURE, PAINTING, Arts of Design, Engraving, Perspective.
	Writing	LETTERS, SYMBOLS, HIEROGLYPHICS, Printing, Mnemonics, Stenography, Abbreviations, Numismatography.
SOCIETIES	Families	MORALS, Biography, Education, Heraldry, Mind, Miracles, Moral Philosophy, Prophecy, Religion, Schools.
	Cities, Nations	CIVICS, POLITICS, History, Institutions, Missions, Political Economy, Poor, Popery, Population, Revenue.
COUNTRIES	Land	GEOGRAPHY, Polar Expedition, America, Britain, China, Egypt, Europe, France, Greece, Hindostan, New Holland, Ireland, India, Rome, &c.
	Sea	HYDROGRAPHY, Navigation.
	Air	AEROLOGY, Aerostation, Aeronautics, Meteorology.
EARTH	Form, Motion, Effects	COSMOGRAPHY, Geology.
PLANETARY SYSTEM.	Forms, Motions, Influences	ASTRONOMY, Dialling, Horology.

The application of the Sciences to the WANTS of Man, constitute the Arts, which are classed under the following general heads, and particular subjects:

GENERAL HEADS.	PARTICULAR SUBJECTS.	PROFESSIONS, ARTS, TRADES, &C.
MEN	In Individuals	MEDICINE, Materia Medica, Midwifery, Poisons, &c.
	In Societies	JURISPRUDENCE, Laws.
	In Nations	WAR, Naval Tactics.
MATTERS	In Production	AGRICULTURE, Coaliery, Fisheries, Veterinary Medicine, Planting, Railway, Roads, Spirituous Liquors, Water Works, &c.
	In Manipulation	MANUFACTURES, Bleaching, Buttons, Calender, Cards, Cloth, Dyeing, Fireworks, Gilding, Glass, Hats, Horn, Ivory, Metallurgy, Paper, Porcelain, Ropes, Soap, Sugar, Tanning, Turning, &c.
	In Exchange	COMMERCE, Banking, Book-keeping, Measures, Money, Ship-building, Trade, Weights, &c.

Anderson's Institution,
Glasgow, Nov. 18th, 1826.

ENCYCLOPÆDIA EDINENSIS.

A.

A, IS the first letter of the alphabet, in all known languages, excepting that of Ethiopia, in which it is the 13th. The simplicity of the sound of this letter has probably obtained for it the first place in most languages; for, in pronouncing it, the lips are merely opened to allow a passage for the voice.

The letter A has three sounds in the English language: *broad*, as in *call*, *malt*; *open*, as in *man*, *ran*; and *slender*, as in *cessation*, *dedication*.

A is employed as the indefinite article, and then denotes the number *one*, as *a man*, *a tree*, that is, *one man*, *one tree*; and it is also prefixed to plural nouns, as *a thousand*, *a million*; but in such cases, these nouns are considered as one aggregate or whole, although composed of a number of individuals. In the following expressions, A denotes *one*, as five pounds *a* week, *a* man, *a* head, or *one* week, *one* man, &c.

A is regarded, by some grammarians, as a substitute for the prepositions *at* or *on*, in such expressions as the following, *a* foot, *a* head, *a* sleep, Thomas *a* Kempis, I am *a* doing, I go *a* hunting, this part is *a* wanting; but when prefixed to the participle, it is clearly redundant.

A was employed by the ancients as a numeral letter, denoting 500, and with a line on the top $\bar{A}$ 5000.

A is used as an abbreviation for many words; as, A. D. anno domini, *year of our Lord;* A. M. anno mundi, *year of the world;* and when preceded by a person's name, artium magister, *master of arts.*

AA, is the name of several small rivers in Switzerland, of some in Germany, of some in Holland, and of one in France.

AAIN-CHARIN, a village near Jerusalem, which is chiefly remarkable for a convent built on the spot where John the Baptist is supposed to have been born. This convent is distinguished for its extent and elegance, and is the frequent resort of pilgrims.

AALBORG, or AALBOURG, a diocese or province of Denmark, and in the northern part of Jutland, is nearly an island, is about 90 miles square, and contains about 81,000 inhabitants.

AALBOURG is also the name of the capital of the above diocese, and signifies *Eeltown*, from the great abundance of eels in the neighbourhood. It is one of the finest cities of Denmark, the population exceeds 1[illegible],000; the trade in herrings and corn is considerable, as well as the manufacture of gloves, saddles, and fire-arms. N. Lat. 57. 3. E. long. 9. 56.

AAM, or HAAM, a Dutch liquid measure, equal to 288 English pints; containing 128 mingles, each weighing nearly 36 ounces avoirdupois.

AAR, is the name of a river in France, and of one in Switzerland, both of which fall into the Rhine.

AARBERG, a town of Switzerland, in the canton of Berne, situated on an island formed by two branches of the Aar, and 12 miles N. W. from Berne. It is also the name of another town in the same canton, and on the same river, distant from Berne 27 miles N. N. E.

AARHUUS, or AARHUSEN, a city and sea-port of a diocese of north Jutland in Denmark, situated in a plain between the lake Guden and the sea. The town has a considerable trade, a population of nearly 15,000, is the seat of an university, and lies in N. Lat. 56. 10. E. Long. 10. 23. The diocese of the same name is 60 miles long and 30 broad, and contains 118,000 inhabitants; the soil is fertile, the country is covered with woods, and its numerous bays, lakes, and rivers abound with fish.

AARON, the high-priest of the Jews, and elder brother of Moses, was specially appointed, by the divine command, to the priesthood among that people. In the deliverance of the Jews from Egyptian bondage, Aaron acted as interpreter to Moses, both in his communications with Pharaoh and his own countrymen. Accompanied by his two sons, and seventy elders of the people, he proceeded half way up Mount Sinai, and remained there, while Moses ascended to the top to receive the law. During this period, Aaron, influenced by the importunities of the people, or fearing their resentment, permitted the golden calf to be set up and worshipped. This happened in the third month after the departure of the Israelites from Egypt. For this sin he was reproved by Moses, and was again admitted to the favour of God; for, in the first month of the following year, he was constituted high-priest, and continued in that sacred office during the remainder of his life. As he was precluded from entering the Holy Land on account of his former distrust of the promises of God, he died in the 123d year of his age, in the 40th year after the departure of the Israelites from Egypt, and was buried in a cave of mount Hor. Aaron died A. M. 2522, and 1452 years before the Christian era.

Aaron, a physician of some celebrity at Alexandria, who wrote a treatise in the Syriac language, on the practice of medicine, before the year 620; and who first distinctly described the small pox and measles, which diseases are supposed to have been introduced into that city when it was taken by the Arabs. A few fragments only of this work are now extant.

Aaron Ben Aser, a learned rabbi, who flourished about the fifth century, and to whom the invention of points and accents in the Hebrew language is ascribed.

AB, is the eleventh month of the civil year of the Hebrews, and the fifth of their ecclesiastical year. It consists of 30 days, and includes part of July and August. The ninth day of this month is observed as a solemn fast among the Jews, on account of the destruction of the temple, which was burnt, first by the Chaldeans, and afterwards by the Romans, both these calamitous events happening on the same day of the year; and it is not a little remarkable, that the edict issued by Adrian, for the exile of the Jews from their native land, was published on the same day of the month.

ABACINARE, a barbarous punishment, which is noticed by writers of the middle ages, and which was inflicted on criminals, by holding a bason of melted metal before their eyes.

ABACK, is a sea-term, expressive of the sails of a ship lying flat on the masts, in consequence of a sudden change of the wind, or of the ship's course, for the purpose of giving the vessel *stern-way*, or of moving backward. In such cases, a ship is said to be taken aback.

ABACUS, the name given to a smooth table covered with sand or dust, on which the ancient mathematicians traced diagrams, and conducted calculations. It is derived from a Phœnician word, *abak*, signifying dust.

Abacus is likewise the name of an instrument for arithmetical operations, and is variously constructed in different countries. In the European abacus, parallel lines are drawn at the distance of twice the diameter of the counters employed. A counter placed on the lowest line, denotes one; on the second line, ten; on the third, 100; and on the intermediate spaces, the counters express one-half of the value of the line immediately above. In the following diagram, the number 1815 is set down both ways.

1000	——O——	——O——	1000
		O	500
800	-O-O-O-O-O-O-O-O-	—O-O-O—	300
10	——O——	——O——	10
		O	5
5	——O-O-O-O-O——	————	

The Roman abacus had pins which were moved in grooves. In the Grecian abacus, brass wires, strung with ivory balls, were stretched on an oblong frame; and of a similar construction is the abacus or shwanpan of the Chinese, which that ingenious people employ with great dexterity in their computations. But, however commodiously constructed, it is obvious, that the general knowledge of written characters, and the use of figures, must supersede such an instrument, and render its description a subject of mere curiosity.

Abacus, or Abaciscus, in *Architecture*, is the highest part or member of the capital of a column, differing in its form in the different orders. See Architecture.

ABADDON is the name which is given by St John, in the Revelations, to the king of the locusts, the angel of the bottomless pit. The word is explained by the inspired writer, and signifies a *destroyer*. Some suppose the angel king to be Satan; and the locusts are understood to be zealots or robbers who infested and laid waste the land of Judea, before Jerusalem fell into the hands of the Romans: while, according to others, Abaddon may have a reference to Mahomet, or to the Serpent Deity, which was anciently the object of worship.

ABANO or Apono, Peter de, a celebrated philosopher and physician, was born in 1250, at Abano, a village near Padua in Italy, from which, according to the fashion of the times, he derived his name. At an early age he went to Constantinople, where he was instructed in Greek, and afterwards studied mathematics and medicine at Paris. Having travelled into different countries, he returned to Italy; was appointed, in 1302, professor of medicine at Padua, which situation he soon resigned, and settled at Bologna as a physician, where his reputation, if it can be correctly appreciated by the magnitude of his fees, rose so high, that for every visit to a patient without the walls of the city he received 50 crowns; and when he attended the pope at Rome, he demanded 400 ducats a-day.

Abano wrote several treatises on astrology, a subject which, with the learned of the times, he seems to have studied deeply, was regarded by the vulgar as a magician, and was supposed to be indebted for his great knowledge to seven familiar spirits, whom he kept confined in a glass vessel. His learning drew upon him the suspicion of the inquisition. He was charged with heresy by that vigilant tribunal, but was acquitted. The charge was repeated when he had reached the 88th year of his age, and death only saved him from a cruel punishment; for the sentence of condemnation was pronounced, and his body was ordered to be raised from the grave and committed to the flames; but being removed by his friends, the sentence could not be farther executed than by burning him in effigy, and this mark of resentment was exhibited in the market-place of Padua. The works of Abano on astrology, scholastic philosophy, and medicine, are numerous and voluminous; but in an age in which some of these studies are exploded, and more enlightened views prevail on the subject of others, they will be rarely consulted.

ABARIS, denominated the Hyperborean philosopher, is supposed to have been a celebrated sage of antiquity, whose history and character, obscured with innumerable fables and conjectures, have been a most fertile subject of learned discussion from the time of Herodotus almost to the present day. Abaris is represented as travelling with an arrow, on which he sometimes took a flight through the air, and as requiring no kind of food; as having visited various parts of Greece, and particularly the city of Athens, to which he was sent ambassador to invoke the prayers of the Athenians, or to assist in some religious ceremony, for the purpose of averting a dreadful plague which then infested the earth. It is said by some that he had an interview with Pythagoras in Italy, was highly favoured by that philosopher, and admitted to the peculiar secrets of his doctrines; while by others he is regarded as a conjurer, or an impostor. Of the native country of this renowned subject of historical criticism, opinions and conjectures have not been less numerous. Some authors assert that he was a native of Scythia, was one of the priests of the Hyperborean Apollo, and when he returned from his travels he presented the gold which he had collected to that divinity; and others, from some peculiarity in his dress, are induced to believe that he was a Druid, and a native of the Hebrides of Scotland. The period when this celebrated personage lived is not fixed by his biographers; and indeed it may be doubted whether he ever had any real existence. But what we have stated affords a striking example of excessive credulity and useless investigation.

ABASCIA, or ABCASSIA, the northern district of Georgia in Asia, and situated on the coast of the Black Sea, between 43° and 45° N. Lat. and 39° and 43° E. Long. The inhabitants, who are generally poor, and charged with being dishonest and treacherous, have some trade in furs, skins, linen-yarn, and bees-wax; but chiefly in female slaves, who are either their own children, or carried off by force, and who being esteemed handsome and beautiful, are in great demand among the Turks, to whom they are usually sold.

ABATIS, or ABATTIS, in *Military Affairs*, a method of defence resorted to in sudden emergencies, in which felled trees are placed together lengthwise, with the branches pointing outwards towards the enemy, for the purpose of preventing his approach. In defending a pass or entrance, the boughs are sometimes stripped of their leaves and pointed, the trunks are fixed in the ground, and the branches are interwoven. This mode of defence, we believe, was practised by Lord Wellington in the lines of Torres Vedras, which were fortified for the protection of Lisbon, and secured with abattis composed chiefly of trees of Spanish oak.

ABBADIE, JAMES, an eminent Protestant divine, was born at Nay in Berne, about the year 1655, and having received the early part of his education in his native place, studied at the university of Sedan. He resided some time in Germany and Holland, accompanied King William into England, and was appointed minister of the French church in the Savoy in London. He was afterwards promoted to the deanery of Killaloe in Ireland, for which he was no doubt indebted to his writings in defence of the Revolution. But he was a man of distinguished talents. His eloquence in the pulpit was greatly admired; and his memory was so retentive, that he arranged and composed his longest works before they were committed to writing. He died at London in the year 1727. Beside the political tract already alluded to, and some others of the same character, he was the author of several theological works written in the French language.

ABBA, in the Syriac language, signifies a father, and, on account of age, or dignity attached to certain official situations, a superior, as the superior of a monastery. See ABBOT.

ABBAS, the son of Abdalmotalleb, and the uncle of Mahomet; is remarkable for having resisted the pretended revelations of his nephew, regarding him as an impostor and a traitor. But being taken prisoner by Mahomet, and a large sum being demanded for his ransom, he attempted to evade the payment, by pleading that it would reduce him to poverty, and thus dishonour his family. When the new prophet reminded him of the immense wealth which he had concealed at Mecca, Abbas, who thought the transaction unknown, was immediately impressed with the belief of the divine authority of the new religion, or perhaps to save and secure his riches, not only became a convert to its doctrines, but a distinguished military commander in its defence, and one of the first doctors of Islamism, or expounders of the Koran, on every chapter of which he is said to have delivered lectures as his nephew received it from heaven. He died in 652, and his memory is still held in the highest veneration by the followers of Mahomet.

ABBE, is the name given to a class of persons in France, who have received the ceremony of tonsure, which entitles them to certain privileges in the church, although they are not in clerical orders. They are employed as tutors in colleges and private families. Some have risen to high situations in the state, and others have been equally distinguished in literature and science.

ABBESS, the superior of a convent of nuns, possesses similar authority with an abbot, excepting the exercise of spiritual functions, for the performance of which some abbesses have had the privilege to grant a commission to a priest. Some abbesses, too, are exempted from episcopal jurisdiction, and are permitted to be present at confession. An abbess is chosen from her own order, and must be 40 years of age before election.

ABBEVILLE, a town of France, finely situated in a fertile valley watered by the river Somme, and distinguished by the name of *Maiden town*, and the motto, *always faithful*, because every attempt to take it has been successfully resisted. The population exceeds 20,000. The manufacture of woollens of fine quality, and the trade in grain, flax, hemp, and coarse linens, are considerable. The Somme is navigable to the town, which is 15 miles distant from the British channel, and 120 miles N.N.W. from Paris. E. Long. 50. 7. N. Lat. 1. 50.

ABBEY, a monastery, or religious house, under the superintendance of an abbot or abbess. In the original endowment of such establishments, it was the intention of their pious founders to afford a comfortable asylum to those who were desirous of withdrawing from the cares and tumult of the world to spend their days in retirement and devotion. But the accumulation of immense wealth, and the acquisition of extensive territorial possessions, introduced such scenes of luxury and dissipation within their walls, and gave them such power and influence in public affairs, as often excited the watchful jealousy of government, and at last led to their final suppression in Britain. As church-property could not be alienated, and as donations to religious houses had become so frequent, statutes were passed to prohibit gifts *in mortmain*, that is, donations to monasteries and similar establishments; and in grants of lands to laymen, clauses are introduced expressly prohibiting them from disposing such lands to monks or Jews.

It seems scarcely credible that the annual revenue of religious houses in England was estimated, in the time of Henry VIII. at the enormous sum of nearly L.3,000,000 Sterling; too rich a prize to escape the rapacity of that monarch, in whose reign they were suppressed. They met with a similar fate in Scotland a few years afterwards. Their immense wealth and extensive possessions were seized by the crown, or by those ministers and favourites who had sufficient influence to obtain a share.

Abbeys, or monasteries, were the seminaries, as well as the repositories of learning; laymen were appointed in some of them for the instruction of youth, and even the monks themselves sometimes undertook that task; and in those religious houses appropriated to women, the education of their own sex, both in useful and ornamental branches, was conducted with great care. The libraries of monasteries were the only safe places, in turbulent times, for the preservation of historical records; and they were amply enriched with the most valuable manuscripts, which had accumulated for ages, and some of which, on account of the beauty of execution and splendour of embellishment, are greatly admired and highly prized in the present day. The sick and poor were admitted into monasteries as into an hospital; the traveller received gratuitous accommodation; and to persons of better condition in life, who had been visited by adversity and indigence, they offered a comfortable asylum. But whatever may have been the benefits of such establishments, the overgrown wealth which they had acquired, and the great mass of industry withdrawn from the community, required some check:—reformation, it cannot be doubted, was necessary; and yet the indiscriminate destruction which followed must ever be seriously regretted, while their venerable remains seem to moulder slowly under the hand of time, as if intended to hold out to distant ages an awful lesson of the fatal effects of misguided zeal and popular frenzy.

ABBOT, derived originally from the Hebrew, and signifying *father*, is the superior of a monastery or abbey of monks. In the early period of the history of monasteries, the abbots were subject to the bishops or ordinary clergy of the district in which they were situated; but when they became rich and powerful, they assumed the rank of prelates, and many of them succeeded in throwing off their dependence on the bishops. Abbots who exercised episcopal authority were called *mitred* abbots: *crosiered* abbots bore the crosier or pastoral staff. There were also *œcumenical*, or universal abbots; and those who possessed authority over all others, were denominated *cardinal* abbots. In Roman Catholic countries, abbots are distinguished by the appellation of *regular*, who take the vow, and wear the habit of the order; and *commendatory*, who are seculars, but have received the ceremony of tonsure, and are bound to take orders at a proper age.

A great deal of ceremony was observed, and splendid feasts were given at the election and installation of abbots. The Dalmatic or seamless coat of Christ, the mitre, crosier, gloves, ring, and sandals, constituted their public dress; while those who sat in parliament were clothed in rich robes. Not less ceremony was observed at the death of an abbot. His seals were formally broken on one of the steps of the great altar; the body, dressed in his pontificals, with his crosier in his hand, was placed in the middle of the choir, where it lay in state for three days; and, thus decorated, was with great pomp and solemnity consigned to the grave.

In Britain, some of the abbots possessed almost regal power. They had the privilege of coining money, of exporting, duty free, the productions of their own domains, and of trying offenders even for capital crimes. The mitred abbots were lords of parliament; and in England, at one period, twenty-seven abbots, called lords abbots, with two priors, sat in the House of Lords.

ABBOT, George, archbishop of Canterbury, was the son of a cloth-worker, and was born in 1562. He studied at Oxford; in 1597 was chosen principal of University College; in 1599 was promoted to the deanery of Winchester; was associated with those engaged in the translation of the Bible, which was begun in 1604 by the direction of James I.; and was employed in 1608 in a mission to Scotland, to unite the churches of England and Scotland under the same form of government. He was consecrated bishop of Litchfield and Coventry in 1609; in a month afterward translated to the see of London; and in the succeeding year he was raised to the first dignity of the church.

For this unexampled rapidity of preferment, the archbishop was no doubt indebted to the royal favour; and it is alleged that it was obtained by servile flattery, of which the following specimen is recorded, and is here inserted as a literary curiosity. Speaking of the king, he says, "Whose life hath been so immaculate and unspotted, that even malice itself, which leaves nothing unsearched, could never find true blemish in it, nor cast a probable aspersion on it. Zealous as a David; learned and wise, the Solomon of our age; religious as Josias; careful of spreading Christian faith as Constantine the Great; just as Moses; undefiled in all his ways as a Jehoshaphat and Hezekiah; full of clemency as another Theodosius." But it ought to be observed, that this strain of learned pedantry was the accustomed mode of the times in addressing the great; and that the conduct of the archbishop was not always marked by the same complying spirit. For, in a case of divorce at the instance of the Countess of Essex against her husband, the Earl of Essex, which was keenly promoted by the king, the matter being referred to a court of delegates, of which the archbishop was a member, he opposed its validity, and forfeited the king's favour; he prohibited the king's proclamation, permitting sports and pastimes on Sunday, from being read at Croydon; and, in the succeeding reign, he refused to license a sermon preached in favour of a loan exacted by Charles, and was for a time suspended from his functions.

While the archbishop was hunting in 1620, he had the misfortune to kill a game-keeper with an arrow from a cross-bow, which was aimed at a deer. This fatal accident impressed him with deep melancholy; and he made every kind of reparation in his power, by settling a handsome pension on the poor man's widow, and keeping a monthly fast on the day on which it happened. But it was followed by a singular investigation, whether he had not forfeited, by this involuntary deed, his archiepiscopal character; the result of which was a dispensation from the king, declaring him absolved from all its consequences, and fully capable of performing all his archiepiscopal functions. He died in 1633, at the age of 71, and was buried at Guildford, the place of his nativity, where he endowed an hospital with a revenue from lands of L. 300 a-year. None of his writings is entitled to much notice. Robert Abbot, the archbishop's elder brother, also rose to a distinguished rank in the church. He was promoted to the see of Salisbury in 1615.

ABBREVIATION, is the contraction of a word by the omission of some letters, or by the substitution of certain marks; has been much practised by professional persons, as lawyers and physicians; abounds in ancient languages and manuscripts, and is of very frequent occurrence in the writings and inscriptions of the Romans.

ABCEDARIAN, or ABCEDARY, a title given to compositions, chiefly poetical, the different parts of which, or the stanzas, begin with the letters of the alphabet, and are arranged in the same order. Such is the 119th Psalm.

ABDALMALEK, the son of Mirvan, and fifth caliph of the race of the Ommiades, was distinguished from all his predecessors by the greatness of his power and the extent of his dominion, and not less so for having excluded the Greek language and characters from the public accounts, and introduced the Arabic numerals now in very general use; a change, it has been observed, which has in a high degree promoted the most important discoveries in mathematical science. His character has been reproached for extreme avarice. Having reigned fifteen years, he died in 699, and in the 80th year of the Hegira.

ABDALS, a sect of people in the East Indies, who occasionally become so infuriated with fanaticism, as to rush into the streets, and destroy every person of a different religion whom they meet; and if they fall in this mad career, their death is considered highly meritorious, and they are venerated by the vulgar as martyrs for their faith.

ABDERA, a town on the coast of Thrace, and near the mouth of the river Nessus, is only remarkable for the extravagant fables concerning it which have been transmitted from ancient to modern times. The inhabitants are characterised as having been extremely stupid. At one time it is said they were banished from their city by immense numbers of frogs and rats; the grass of the surrounding country is described as being of such a noxious quality, that the horses which fed upon it were seized with madness; and the unfortunate people themselves, after being present at the performance of the Andromeda of Euripides, during a hot summer, were attacked with fever and delirium, under the effects of which they fancied themselves players, and imitating the looks and gestures of the different characters, indulged in violent tragic exclamation. This dramatic delirium, it is added, became epidemical, raged during the whole summer, and was only subdued by the cold of winter. Abdera is now only a small village.

ABDOLLATIPH, an Arabian physician and philosopher, was born at Bagdad in the year 1161; and having made great proficiency in rhetoric, history, and poetry, as well as in the doctrines of Mahommedan theology and medical knowledge, he left his native city in the 20th year of his age, for the purpose of visiting other countries. Having spent a year at Mosul in Mesopotamia, he removed to Damascus in Syria, where he obtained a victory over a celebrated grammarian, in a controversy on some literary subjects.

Abdollatiph, anxious to visit Egypt, found it necessary, for the successful prosecution of this journey, to obtain the permission and protection of Saladin, king of the Saracens, to whose arms that country had yielded, and who was now marching against Palestine for the purpose of expelling the Christians from the Holy Land. When the traveller arrived at the camp before Acre, he found the Saracens bewailing a defeat which they had recently experienced, and the lofty spirit of the Sultan sunk in melancholy, so that he was disappointed of a personal interview. But although he was solicited, with the promise of a pension, to leave the seat of war and return to Damascus, he persisted in his resolution of exploring the wonders of Egypt: and, aided by the munificence of Saladin, and the recommendations of one of his ministers, he received the most cordial welcome when he reached Cairo, and continued, during his stay in that city, to enjoy the esteem and friendship of persons of the highest rank.

Abdollatiph withdrew from the agreeable and instructive intercourse with the great and the learned in Egypt, to present himself before the Sultan, who had concluded a truce with the Christians, and then resided in Jerusalem; and he was received by that prince, who was greatly distinguished by dignified politeness, and munificent liberality in the patronage of science and art, with every expression of esteem for his character and attainments. The Sultan, besides, bestowed upon him a monthly pension, which was increased threefold by his sons and successors, and continued till they were driven from the throne of Egypt and of Syria by the ambition of their uncle; and thus, after a short residence in Jerusalem, the traveller was compelled to revisit Damascus, where his lectures and writings were equally the objects of applause and admiration, while his practice as a physician was extensive and lucrative. But his thirst for knowledge, or his desire of contemplating new scenes, again seduced him from the certain pursuit of fame and wealth. He left Damascus, visited Aleppo, resided several years in Greece, and travelled through different regions of Armenia and Asia Minor. Impressed with sentiments of devotion, he resolved to undertake a pilgrimage to Mecca; and, in the meantime, he felt a strong desire of beholding the place which gave him birth; and with this view, he eagerly journeyed towards Bagdad. But he had scarcely reached his native city when he was seized with an illness, which carried him off in the year 1223, and in the 63d of his age. Of 150 treatises which have been ascribed to the industry of Abdollatiph, only one is known to exist, the *Compend of the History of Egypt*, the manuscript of which was brought to Europe by the celebrated traveller Dr Pococke, and is now preserved in the Bodleian library, in Oxford. Dr White published an edition of this work in the original Arabic, with an elegant Latin version, in 4to, in the year 1800.

ABDOMEN, is that part of the trunk of the body situated between the thorax and the pelvis. See ANATOMY.

ABDOMINAL Fishes, or ABDOMINALES, is the name of the 4th order of fishes, according to the Linnæan classification.

ABDUCTORES, or ABDUCTORS, are such muscles as serve to separate or draw away the parts to which they are attached. Of this description are the muscles which separate the fingers.

ABEL, the second son of Adam and Eve, was a shepherd, and offered, in sacrifice to God, of the firstlings of his flock; while his brother Cain, who was a tiller of the ground, offered of the fruits of the earth. God was pleased with the offering of Abel, but he was displeased with that of Cain. The sacred historian is silent on the cause of this preference, or in what manner the displeasure of God was expressed; but the consequence was, to excite a deadly hatred in the breast of Cain against his brother, whom he invited into the field, and put to death. It seems somewhat unaccountable, that the Greek churches, which celebrate feasts in honour of every other patriarch and prophet, pass over the martyrdom of Abel unnoticed; and among the Roman Catholics, his name was not introduced into the list of saints and martyrs before the tenth century. But he is invoked, in some litanies, for persons who are at the point of death.

ABELARD, PETER, an eminent scholastic philosopher of France, whose story and misfortunes, in conjunction with those of Heloise, the object of his attachment, present a striking feature in the annals of the times, and became the theme of the poet in distant ages, was a native of Brittany, and was born in the year 1079. Possessed of vigorous and active intellectual powers, he discovered, at an early age, those talents which were requisite to make a conspicuous figure in the learning of the schools; and, destined by his father to the pursuit of letters, he was entrusted to the care of Rosceline, a celebrated teacher, and founder of the metaphysical sect called Nominalists. By his own assiduity, and the instructions of this able master, he had acquired, at the premature age of sixteen, that subtlety and quickness of thought, fluency of speech, and facility of expression, which were the necessary qualifications to appear with advantage in the field of disputation. Having visited several provincial schools, in his twentieth year he entered the university of Paris, and placed himself under William de Champeaux, the master, whose reputation at that time stood high. But Abelard was not satisfied to remain long in the humble capacity of a pupil: he ventured to contradict the opinions of his master, and held public disputations with him, from which he frequently retired victorious. This success, while it excited the jealousy of De Champeaux, increased the vanity of Abelard, and roused his ambition to aspire after the higher distinction of appearing as a teacher. At the age of twenty-two, he opened a public school at Melun, ten leagues from Paris, and soon had the gratification of seeing himself surrounded with crowds of scholars. But his restless disposition and insatiable vanity, or perhaps some feelings of resentment against De Champeaux, who had employed all his influence in opposing the establishment of his school, prompted him to renew the contest of disputation; and for this purpose he removed to Corbeil, near Paris. A challenge was offered and accepted; the disputants frequently met in each other's schools; the contest was supported with great ardour in the presence of crowded auditories; and the palm of victory was again assigned to the youthful teacher.

Declining health, the consequence of severe study, required Abelard to withdraw from his labours, and retire for a time to his native country. Returning to Corbeil at the end of two years, he found that De Champeaux had taken the monastic habit, but still continued to teach logic and rhetoric, and to hold public disputations in theology. Abelard returned to the charge, again foiled his adversary, and soon attracted crowds of De Champeaux' scholars, among whom he had the gratification to number the new professor, who had surrendered his chair to the young philosopher. De Champeaux, stimulated by resentment, obtained the appointment of another professor, and thus drove back Abelard to his former residence at Melun. This violent measure was unsuccessful. De Champeaux retired to the country; Abelard returned to Paris and resumed his lectures, which were soon crowded by the pupils of the rival school; and De Champeaux re-appearing on the field, had the temerity to renew the contest, in which Abelard was still victorious.

The promotion of De Champeaux to the see of Chalons, terminated the long-contested struggle between the two philosophers; and Abelard, for want of a rival, or perhaps from his unsettled disposition, resolved to exchange the study of philosophy for that of theology. With this view he repaired to Laon, and placed himself under Anselm, a professor of theology of high celebrity. But although the teacher possessed great fluency of language, he communicated little instruction: "He was," says Abe-

Abelard. lard, " a tree covered with a thick foliage, which pleased the distant eye, but, on a nearer inspection, there was no fruit to be found." Abelard retired from these unprofitable lectures; and in a conversation with some of Anselm's pupils, having expressed his opinion that the explanation of the Scriptures was a task of no great difficulty, he undertook, with one day's previous preparation, to give a comment on any part they should point out. The beginning of the prophecy of Ezekiel was fixed upon; and next morning he delivered a lecture on the passage, which was received with admiration and applause. The lectures were continued, and for several successive days attracted a crowded audience. But the rising fame of the young theologian excited the jealousy of the professors, who prohibited the lectures. Abelard obeyed the prohibition, and removed to Paris, where he opened a school of theology, and commenced with his lectures on Ezekiel, which met with equal applause, and drew multitudes of scholars from every part of Europe.

The eventful period of Abelard's life now approaches. Ambition and vanity have hitherto been the ruling principles of his conduct; and the splendid reputation of an able philosopher and subtle disputant which he had acquired, afforded them ample gratification. Other passions now fill his bosom, and other pursuits occupy his thoughts. In the house of Fulbert, a canon attached to the cathedral church of Paris, Heloise, his niece, a lady of eighteen years of age, greatly distinguished for her personal charms, and no less celebrated for her literary attainments, was at this time an inmate. Abelard saw her, was struck with her blooming beauty, and determined to captivate her affections. Fulbert, who regarded the frequent visits of Abelard as a high honour, was at last prevailed upon, by the offer of a handsome gratuity, to admit him into his family; and such was the canon's confidence in the honour and integrity of the philosopher, that he requested him to undertake the instruction of his niece; a trust which Abelard readily accepted, but, it would appear, for the base purpose of betraying it. An unfortunate amour was the consequence of the familiar intercourse which now commenced between them, and was notorious to all, excepting the unsuspecting Fulbert, whose partiality for his niece, and respect for Abelard, excluded every surmise of impropriety. But when concealment was no longer possible, it is not easy to imagine with what feelings of surprise and resentment he received the news of the fatal discovery. Heloise retired to the house of Abelard's sister, in Brittany, where she was delivered of a son. On condition that the marriage should be kept secret, Abelard proposed to Fulbert to make Heloise his wife. The canon consented; but Heloise, in the wild enthusiasm of romantic love, at first rejected the proposal, preferring to live in the character of mistress with one the laws of whose profession required celibacy. Her consent was at last obtained, and the ceremony was privately performed at Paris. From this time Fulbert treated his niece with harshness and severity, which induced Abelard to remove her from his house, and place her in the nunnery in which she had been educated. Fulbert, suspecting that Abelard's real intention was Abelard. to dissolve a connection which tended to mar his future prospects, and urged by resentment, vowed revenge. For this purpose, he hired ruffians, who entered Abelard's chamber by night, and brutally attacked and wounded him. The ruffians were punished; and Fulbert, beside the confiscation of his goods, was deprived of his benefice. But Abelard's spirit sunk under the misfortunes and barbarity which he had suffered; he resolved to spend the remainder of his days in the shades of a convent, and most ungenerously required Heloise to make a similar sacrifice; nay, even insisted that she should first renounce the world, fearing that, if he were once engaged, she might violate her solemn promise. Heloise obeyed, and took the veil; and, in a few days after, Abelard assumed the monastic habit in the abbey of St Denys.

But the dull routine of a convent was ill suited to the restless ambition of Abelard. Invited by his former admirers and scholars in Paris, he resumed his lectures at a small village in the country, and soon collected a numerous audience. The revival of his popularity excited new jealousies; the dæmon of persecution was let loose against him; and a treatise on theology, published about this time, was condemned as heretical, and Abelard was sentenced to commit it with his own hands to the flames. Dreading the consequences of new charges of heresy, he fled from his persecutors, concealed himself for some time in a convent in Champagne, and was permitted to retire to a solitary retreat, on condition that he should not again become a member of a convent. A vale in the forest of Champagne was the spot which he chose for his retirement; and in 1122 he erected a small oratory, which was dedicated to the Comforter, or Paraclete. When the place of his retreat was known, scholars flocked to him from all quarters; and his rustic college could, in a short time, number not fewer than six hundred pupils. But jealousy again provoked his enemies; and while he was meditating his escape from new persecutions, through the interest of the Duke of Brittany he was elected superior of the monastery of St Gildas, where, although not altogether unmolested, he spent several years of his life.

About this time the convent of Argenteuil, of which Heloise was prioress, was annexed to St Denys, and the nuns, who were charged with irregularities, were dispersed. When Abelard was informed of her destitute situation, he invited her, along with eight of her companions, to accept of the Paraclete as an asylum. During Abelard's residence at St Gildas, the correspondence between him and Heloise took place: and from the letters of Heloise, which discover undoubted marks of genius, learning, and taste, Pope has derived the subject of his " Epistle from Eloisa to Abelard;" a highly poetical composition, although not strictly consonant either to the character and story of Heloise, or to moral propriety. Here too it is supposed Abelard wrote his " Theology," which was pronounced heretical by a council; the judgment was confirmed by the Pope; and he was sentenced to perpetual silence and imprisonment. The interposition of friends, and a

Aberbrothick. submissive apology, procured him a pardon, and permission to spend the remainder of his days in the convent of Clugny. Here, excepting occasional lectures, which he delivered at the solicitation of the monks, his time was chiefly occupied in study and devotion till his death, in 1142, and in the 63d year of his age. His body was sent to the Paraclete to be interred. Heloise survived Abelard twenty-one years, and was buried in the same grave. The following epitaph, which is a model of simplicity, elegance, and characteristic expression, was drawn up at the request of the abbess of the Paraclete to the Academy of Belles Lettres, in 1766, and inscribed on their tomb; which was removed, about the commencement of the revolution, and placed in the National Museum:

Hic,
Sub eodem marmore, jacent
Hujus monasterii
Conditor, Petrus Abelardus,
Et Abbatissa prima, Heloisa,
Olim studiis, ingenio, infaustis nuptiis,
Et pœnitentia,
Nunc, æterna, ut speramus, felicitate,
conjuncti.
Petrus obiit 21mo Aprilis 1142;
Heloisa, 17mo Maii, 1163.

The character of Abelard, after the preceding detail of his life, requires no particular delineation. Excessive vanity, insatiable ambition, a restless and turbulent temper, were its more prominent features; and whatever may be said of the illiberality and caprice of the times, the endless controversies and persecutions in which he was involved must be in a great measure charged on himself. But it cannot be doubted, that he who drew together crowded auditories wherever he appeared as a public teacher, and foiled the ablest masters in the art of disputation, possessed talents of no ordinary kind. The conduct of Abelard towards Heloise was treacherous and base; and the deliberate plan of seduction which he formed and executed, has fixed a lasting stain upon his memory. The ardour and inexperience of youth have been advanced as an excuse for Heloise; and romantic attachment, generosity, and sensibility, have been held up as a veil to human frailty. But if such sentiments have much influence on the female character, its beauty and excellence are surrounded by feeble barriers, and it will not be difficult to find an apology for female indiscretion.—The works of Abelard, which are chiefly theological and controversial, and written in the Latin language, do not merit particular enumeration.

ABERBROTHICK, or Arbroath, a royal borough and sea-port town in the county of Forfar, or Angus, in Scotland, and situated at the mouth of the small river Brothic, from which it derives its name. The early history of Arbroath is chiefly connected with its abbey, the ruins of which afford indubitable proofs of its former wealth and magnificence. King William the Lyon granted the privileges of a royal borough to Arbroath about the middle of the 12th century, and founded the abbey in 1178. The abbey was dedicated to Thomas à Becket, archbishop of Canterbury, was occupied by Tyronensian monks from Kelso, and, by various grants and donations, became one of the richest and most distinguished for its privileges of any in Scotland. The abbot was permitted to assume the Episcopal dress, and to exercise Episcopal jurisdiction; and John, King of England, conferred on the citizens of Arbroath the very unusual privilege of trading duty free in every part of his kingdom, London excepted. The last ecclesiastical abbot of Arbroath was Cardinal Beaton. It was erected in 1608 into a temporal lordship, in favour of the Marquis of Hamilton, afterwards became the property of the Earl of Dysart, and was purchased by Maule of Panmure, in whose family it remained till 1715, when it was forfeited.

The population, manufactures, and trade of Arbroath have increased during a century past. The population in 1801 exceeded 7000, and, including the suburbs, is not less than 9000, who are employed in the manufacture of brown linens, or osnaburghs, and sail-cloth. In the year 1804, the brown linen which passed through the Stamp-office amounted to 1,129,495 yards, and was valued at L.62,097; and in 1809 it amounted to 1,484,425 yards, valued at L.83,454. The annual value of the sail-cloth manufacture is estimated at L.100,000. The British navy is supplied with canvas by ten sail-cloth manufacturers of Arbroath. A tan-work has been also established. The harbour, which was first constructed in the early period of the abbacy, and has of late been extended and improved, is safe and commodious, and admits vessels of 150 or 200 tons. Fifty vessels, from 50 to 150 tons burden, are employed in the London, coasting, or Baltic trade. The principal imports are flax, hemp, tallow, and ashes, from the Baltic. The harbour duties, which, in 1717, did not much exceed L.29, were farmed, in 1807, for L.735. A new town-house, including a prison and public offices, has been lately erected; and a library, established in 1797, is rapidly increasing. N. Lat. 56. 33. W. Long. 2. 34. and about 56 miles N.N.E. of Edinburgh.

Aberdeen. ABERDEEN, County or Shire of, in the north of Scotland, is bounded on the north by the Moray Frith; on the east, by the German Ocean; on the south, by the counties of Kincardine, Angus, and Perth; and by Inverness, Moray, and Banff, on the west. Its greatest length, from north-east to south-west, is between 50 and 60 miles, and the breadth from 25 to 30. The superficial extent is estimated at 1200 square miles, and it is divided into 85 parishes. The western parts of Aberdeenshire are mountainous and rugged, and in many places covered with extensive forests. On some parts of the sea-coast, there are considerable tracts covered with blowing sand, while others are terminated by stupendous rocky precipices. Of this latter description are the Bullers or Boilers of Buchan.

The mountains of Aberdeenshire are chiefly composed of granite; this, indeed, is the prevailing rock through the whole county. The quarries of beautiful gray granite, near Aberdeen, have been long celebrated. The stone dug from these quarries, and annually exported to London, is valued at nearly 9000 Sterling. Limestone is abundant, but the want of coal is a bar to its general use. Some parts of the county afford excellent millstones and blue slate. A vein of manganese, discovered near Old Aberdeen, furnished splendid specimens of that mineral in the crystallized state; but being too hard, or impure, it was found unsuitable for the purposes of the manufacturer. The crystals of smoky quartz, known by the name of *Cairngorum stones*, are found in the alluvial soil, on the sides, and at the foot of the mountains, in the interior of the county. A considerable number of persons is employed, during the summer months, in searching for these stones, as well as for another beautiful mineral of an azure blue colour, and to which the name of topaz has been, perhaps inappropriately, assigned. Some masses of Cairngorum stone have been sold in Edinburgh at from L.40 to L.50. Fluor spar, so abundant in the mining districts of England, as a production of Scotland, appears only in this county; some places of which, also, afford indications of lead ore. The mountains produce many of the rarer Alpine plants of North Britain; and *Linnæa Borealis*, the generic title of which commemorates the father of botany, grows in a wood on the borders of the county, the only spot in which it has been discovered in this kingdom.

The rivers of Aberdeenshire are, the Dee, the Don, the Ythan, the Urie, Ugie, and the Cruden. The principal of these are the first two, which derive their origin from the mountains in the west, traverse the county, nearly parallel to each other, to the eastward, and discharge their waters into the German Ocean; the Dee, at New Aberdeen, where it forms the harbour; and the Don, to the north of Old and New Aberdeen. There are many mineral springs in this county; those of Peterhead, Glendee, and Pannanach, have acquired the greatest celebrity, and are places of chief resort. Aberdeenshire contains a number of the chief seats of the Scottish nobility, as those of the Marquis of Huntley, of the Earls of Errol, Kintore, Aboyne, Fife, Aberdeen, and of Lords Salton and Forbes, besides many elegant residences belonging to private gentlemen. The agricultural improvements, which have been, of late years, introduced into Scotland, by the spirit and activity of many of the proprietors, have made no inconsiderable progress in this county. The late Dr James Anderson, whose ingenious speculations and numerous writings have greatly served to illustrate almost every branch of rural economy, was a native of Aberdeenshire, in which he commenced his researches on these important subjects. The real land rent of Aberdeenshire is estimated at L.133,632 Sterling. The population, in 1755, amounted to 117,000; in 1801, to 123,000; shewing an increase of 6000 inhabitants in the period of 46 years.

The sea-coast of this county abounds with excellent fish, and affords employment to a considerable proportion of the inhabitants. The salmon-fishery on the Dee and the Don is the most valuable, yielding a rent of nearly L.3000 annually, and the produce is stated at L.10,000. The greater proportion of the salmon taken in these rivers is pickled, and exported to the London market. Several ships from Aberdeenshire are employed in the Northern Whale Fishery. The produce of four ships from Aberdeen, in the period of the last seven years, is estimated at L.140,000, and of these from Peterhead, in the year 1813, at L.40,000.

The knitting of stockings and hose was formerly carried on to a great extent; but in consequence of the state of the Continent, during the French revolutionary war, that branch of manufacture had declined. It has since revived, by the introduction of spinning machinery, and is now in a more flourishing condition than at any former period. Machinery for spinning wool was first introduced into Scotland by Mr Baird of Aberdeen. It was erected in 1789, on the river Don; in the year 1799, 4000 lbs. of wool were weekly manufactured by 18 engines. The most considerable work of this kind, in Scotland, is that of Messrs Adam and Company at Aberdeen, which extends to 20 machines, driven by two powerful steam engines; and since the introduction of machinery, superfine broad cloths, equal in quality and price to the best made in England, are manufactured in this county. Carpets also form an article of manufacture in Aberdeenshire. The linen manufacture is considerable; and one of the most extensive establishments in Britain for spinning flax by means of machinery, is situated at Grandholme, on the river Don, two miles from Aberdeen; and, at the same place, there are 16 power looms, or looms for weaving cloth by machinery, which are peculiarly distinguished by elegant construction, and ingenious mechanism.

Among other improvements in this county may be mentioned the construction of two timber bridges; the one over the Don, about seven miles from Aberdeen, on the road to Banff, of a single arch, 109 feet in span, with an elevation of 13 feet, which was finished in 1803; and the other, of two arches, each 71½ feet span, and an elevation of 10½ feet, erected at Grandholme, for the accommodation of the extensive spinning establishment of Messrs Leys, Mason, and Company; and a canal from Aberdeen to Inverury, a distance of 18 miles, which was opened in the year 1807. This canal is from 21 to 23 feet wide, nearly four feet in depth, and cost about L.44,000 Sterling.

Aberdeen, Old and New, two cities in the north of Scotland, each governed by its own magistrates; and the latter is the capital of the county of the same name.

Old Aberdeen is a mile distant from the New Town, and not far from the river Don, over which there is a Gothic bridge of a single arch, of 67 feet span and 34½ feet high, which was built in 1290. Tradition ascribes great antiquity to Aberdeen, as being a place of importance in the ninth century. The bishoprick is said to have been translated from Banffshire in the 12th century; and in 1217, similar privileges with those of Perth are granted to Aberdeen. The cathedral, of which one aisle, still used as the parish church, and two spires, are the only remains, was dedicated to St Machar. The fine library attached to this cathedral was totally destroyed in 1560.

The University, or King's College, was founded in 1494, by Bishop Elphinston, who was lord chancellor of Scotland in the reign of James III., and privy seal in James IV.'s time. The latter monarch claimed the patronage, and hence its name. The buildings of King's College are arranged in a quadrangular form, with an open court in the middle, and they are adorned with a fine tower, which is surmounted with an imperial crown. This seminary consists of a principal and eight professors, and it is furnished with a considerable library. The first principal of this college was Hector Boethius, the historian of Scotland. He was invited from Paris to accept of the appointment, with a salary of 40 merks Scots, or about L.2, 4s. 5d. Sterling. The population of Old Aberdeen, including the parish, exceeds 8000.

Aberdeen, New, the capital of Aberdeenshire, is situated on a rising ground, near the mouth of the river Dee, and seems to have been a place of considerable antiquity, if we can judge from the number of religious houses which were established in it; one of which was erected previously to the year 1214. About the beginning of the 14th century, Aberdeen was burnt by the English; and, in consequence of new buildings being erected, it obtained, according to some accounts, the name of New Aberdeen. The church in the High Street, which formerly belonged to the Franciscans, is said to have been begun by Bishop Elphinston, and finished by his successor Bishop Dunbar. The same Bishop Elphinston also provided funds for building the present bridge over the Dee; the execution of which was superintended by Bishop Dunbar. Many of the streets of Aberdeen are spacious; and the houses, which are built of granite, are elegant. Aberdeen contains numerous public buildings and charitable establishments; as, the town-house, with a handsome spire; the prison, with its square tower, surmounted with a spire; the cross, an octagon building in Castle Street; the poor-house, a large building; the infirmary, which annually admits a thousand patients; and the barracks, erected on the site of a fortification which was constructed by Oliver Cromwell. But the chief building in Aberdeen is Marischal College, endowed, in 1593, by George Keith, Earl Marischal of Scotland. This seminary consists of a principal and eleven professors. The common hall contains some fine paintings by Jamieson, who has been distinguished by the name of the Scottish Vandyke, and was a native of Aberdeen. An observatory, furnished with astronomical apparatus, is connected with this college; and the library, and museum of natural history and of antiquities, are respectable. The number of students, including those of King's College, is stated at between 300 and 400.

Aberdeen has lately received some essential improvements, in opening up two elegant and spacious streets, the one leading to the north, and the other to the south. For the accommodation of the latter, a stupendous arch of cut granite, having a span of 130 feet, 29 feet of elevation, and 40 feet within the parapets, has been erected. The harbour, too, has been greatly improved of late years, and particularly by constructing a pier of 1200 feet in length, at an expence of L.17,000.

The trade of Aberdeen, in tobacco, was at one time considerable. Some merchants are, at present, connected with the West Indies and North America; but its chief imports are from the Baltic; and the exports are manufactured articles of the town and county; fish, pickled pork, and granite from the neighbouring quarries. The population in 1801, is stated at 17,600. N. Lat. 57. 8. W. Long. 2° 8', and 120 miles N. E. from Edinburgh.

ABERDOUR, a small town in Fifeshire in Scotland, and situated on the north bank of the Frith of Forth, is a place of some note in antiquity. A convent of nuns of the order *poor Clares*, was established, and the monks of Inchcolm had the privilege of a burial place in Aberdour. The Earl of Morton and his predecessors have been superiors or lords of the manor since the time of David II. The population is about 1000, who are chiefly employed in the manufacture of coarse cloth.

ABERGAVENNY, a town of Monmouthshire, in England, and situated in a rich and beautiful valley, at the conflux of the rivers Gavenny and Usk, over which is a fine gothic bridge of fifteen arches. A priory was founded here in the eleventh century; and the castle, now in ruins, was frequently the scene of treachery and bloodshed, in the earlier periods of English history. This place, of which the population, in 1801, exceeded 2500, is chiefly known as a considerable market for flannels. It is 143 miles W. from London.

ABERNETHY, John, an eminent dissenting clergyman, was born at Coleraine, in the north of Ireland, in October 1680. His father was a dissenting minister in that place; and being called to England on some public affairs, he left his family to the care of his wife, when young Abernethy was in his ninth year. The disturbances which then existed in that part of the kingdom compelled her to retire, with her family, to Derry; and, in consequence of the sufferings and privations to which those within the walls were subjected during the memorable and disastrous siege of that place, she lost all her children excepting John, who then lived with a relation, whom he accompanied to Scotland. In his thirteenth year, he commenced his studies in the University of Glasgow, where he was admitted to the degree of master of arts. He afterwards studied divinity at Edinburgh. In the year 1708, he was appointed minister of the dissenting congregation at Antrim, and held that situation for twenty years. A controversy having arisen concerning subscription to the Westminster Confession of Faith, he became one of the principal leaders among those who opposed it, and was subjected to the censure of a general synod; and being deserted by many of his congregation, he accepted of an invitation to become minister of a dissenting congregation in Dublin; in which situation he continued for ten years, greatly respected and esteemed. He had been formerly subject to the gout; and in consequence of a sudden attack of that disorder, he died in December 1740, in the sixty-first year of his age.

Mr Abernethy was greatly admired as a preacher. His writings in general are distinguished by liberal and manly sentiments. His discourses on the Divine Attributes have obtained considerable celebrity, and are much read and admired. Several posthumous volumes of his sermons were published by his friends.

Abernethy, a small town in Strathern, a district of Perthshire, in Scotland, and situated on the river Tay, is said to have been the metropolis of the Pictish kings, and also the see of a bishop, afterwards transferred to St Andrews. But this place is now distinguished only by a singular tower, of a circular form, 74 feet in height, and 48 in circumference. These towers are not unfrequent in Ireland. One at Brechin is the only instance of a similar structure in Scotland; but of the purposes for which they were intended, whether as places of confinement, or of penance, as has been supposed, the conjectures of antiquarians furnish no elucidation.

ABERRATION, in *Astronomy*, an apparent motion of the heavenly bodies, or a seeming change in the position of the fixed stars, which is produced by the progressive motion of light, and the annual motion of the earth. This important discovery was made in 1725, by the late Dr Bradley, astronomer-royal. See ASTRONOMY.

ABERRATION, *in Optics*, the deviation of the rays of light, when reflected by a speculum, or refracted by a lens, which prevents them from meeting in the same point, called the geometrical focus, but which are spread over a small space, and produce a confusion of images. There are two species of aberration distinguished by their different causes; the one arising from the figure of the lens or speculum, and the other from the unequal refrangibility of the rays of light. See OPTICS.

ABERRATION, *of a planet*, is the space through which it appears to move, as seen from the earth, during the time that light passes from the planet to the earth. See ASTRONOMY.

ABESTA, or AVESTA, a sacred book of the Persian Magi, which is supposed to be the production of their great founder Zoroaster. This work is a commentary on two of their religious books, called *Zend* and *Pazend;* and these three comprehend the whole system of their religion.

ABEX, a mountainous country of Ethiopia, extending along the coast of the Red Sea, 500 miles in length, and about two in breadth. The soil is sandy and barren, the country destitute of water, and greatly infested with wild beasts, and the forests abound with ebony trees. It is subject to the Turks; and Suakem and Arkeeko are its chief towns.

ABEYANCE, *in Law*, is the expectancy of an estate or possession; as, for instance, lands are leased to one person for life, with reversion to another for years; the remainder for years is said to be in *abeyance*.

ABGAR, or ABGARUS, the name of several kings of Edessa, in Mesopotamia, one of whom has been the subject of controversy among ecclesiastical writers, on account of a letter which he is said to have written to Jesus Christ, requesting him to come and cure a distemper of his feet. This letter, and the answer, according to the assertion of Eusebius, by whom they were translated from the Syriac, were preserved in the archives of the city of Edessa. The authenticity of these letters is denied by some divines, while it is admitted by others of no less respectability.

ABIANS, a wandering tribe of Thracians, or Scythians, who lived chiefly on the productions of their herds and flocks; had no other dwellings than their waggons; assigned the privilege of the cultivation of their lands to others, for a small compensation; and were greatly distinguished for their integrity; in allusion to which, Homer eulogizes them as the most honourable men.

ABIB, originally signifying an ear of corn, is the Jewish name of the first month of the ecclesiastical year, corresponding to the latter part of March and the beginning of April.

ABINGDON, a town of Berkshire, in England, is supposed to be the place called Cloveshoo in the Saxon annals, and contains two churches, several charitable institutions, and a free school. At this place a considerable quantity of malt is made, and transported to London by the Thames, which is here navigable for barges. There is also a manufacture of sail-cloth and sacking. Population, in 1801, was 4356. It is seven miles south from Oxford, and 56 W. N. W. from London.

ABIPONIANS, a wandering tribe of Indians, who inhabit the district of Chaco, in Paraguay, of whom, it seems probable, very inaccurate and exaggerated accounts have been related. They are represented as a bold and independent people, much occupied in hunting and war. They possess many horses; and, in a single incursion against the Spaniards, sometimes carry off several thousands. Polygamy is admitted; and the barbarous practice of destroying their offspring is quite common among the women. The Abiponians, like every other uncivilized people, are greatly influenced by their soothsayers, without whose advice no undertaking is attempted. A singular custom is said to prevail among them. The moment a person expires, he is wrapt up in a hide, and committed to the earth. The hut in which he lived is thrown down; all things which belonged to him, his horses, and other animals, are destroyed; his widow and children remove to a distant country, and every memorial of the deceased is obliterated. The number of this savage people is now reduced, by wars and other causes, to 5000. The attempts of the missionaries to convert them to the Christian faith have not succeeded.

ABJURATION, Oath of, signifies the renouncing and denying the right of the Pretender to the crown of Great Britain.

ABLAI, or ABLAY, a country of Great Tartary, the inhabitants of which are called *Buchars;* are governed by a Calmuck chief, but are subject to the Russian government. This country extends 500 leagues along the southern frontier of Siberia.

ABLATIVE, in *Grammar*, is the sixth case of Latin nouns, to which some suppose there is no corresponding case in the Greek language. It may be said in general to denote concomitancy, which is expressed by the use of *with* or *from* in the English language. There is, strictly speaking, no such thing as the ablative absolute in the language of grammarians; for what has been invariably so denominated, by Ruddiman and others, is nothing more than the expression of a concomitant circumstance. *Sole oriente fugiunt tenebræ*, While the sun rises, darkness flies away. The flying away of the darkness is the result of the rising of the sun; so that the one is a concomitant circumstance of the other. See GRAMMAR.

ABLE, or ABEL, a clergyman who was chaplain to Catherine, queen of Henry VIII. and greatly distinguished himself in opposing the proceedings against her for a divorce. In 1534, he was prosecuted for being concerned in the affair of Elizabeth Barton, called the holy maid of Kent, who announced herself as a prophetess. She was condemned and executed, along with several of her accomplices; and Able being charged with misprision, or concealment of treason, was thrown into prison. He was afterwards convicted of denying the supremacy over the church, which Henry, in his arbitrary manner, had assumed, and strenuously maintained; and he was condemned to be hanged, drawn, and quartered; which sentence was put in execution in Smithfield, in the year 1540.

ABLUTION, a ceremony connected with religious rites, in very general use among ancient nations, and still practised in different parts of the world, consists in washing the whole, or parts of the body, before offering sacrifice, or performing other religious duties. These washings are of remote antiquity; they were enjoined by the Jewish lawgiver, and adopted both by heathens and the followers of Mahomet. They were practised by the Egyptians, Greeks, and Romans, as well as by the first Christians, and they are still observed by Roman Catholics and Mahometans.

ABO, a seaport town, and capital of Swedish Finland, situated on the promontory formed by the gulfs of Bothnia and Finland, and about 120 miles north-east from Stockholm. The town is built on both sides of the river Aurajocki, and has a communication by means of a wooden bridge. The population, in 1791, was nearly 9000. The manufactures are, sail-cloth, fustians, silk ribbands, leather, paper, tobacco, watches, and clocks. The trade is considerable: iron, copper, tar, and deals are exported; and coffee, sugar, wine, salt, grain, &c. are imported. The plantations of tobacco in the vicinity yield annually, it is stated, 152,000 cwt. of tobacco.

The Russians took possession of Abo in 1713, and retained it for seven years. A gymnasium, founded by Gustavus Adolphus in 1626, was converted into a university, by Queen Christina, in 1640, in which are now taught, anatomy, natural history, chemistry, &c. The same queen established the library, which consists of 10,000 volumes, besides manuscripts, ancient coins, medals, &c. The school of anatomy, which is said to be in considerable repute, enjoys a very extraordinary privilege. All persons who hold lands or pensions from the crown, are bound, by a particular regulation, to leave their bodies to be dissected, for the instruction of the students.

ABOLITION, the act of making void, or annulling; and, in our law, the repealing of any statute. When a prince granted liberty to a criminal accuser to give up the farther prosecution of the party accused, it obtained the name of abolition. Civilians employ it to denote remitting the punishment of a crime. It signified, in the *Roman Law*, the annulling of a legal prosecution, and of course differed from an *amnesty*, by which an accusation was extinguished for ever. *Abolition* also denoted the erazing of a person's name from the public list of the accused, which was hung up in the treasury. It was either public or private; the former like that under Augustus, when all the names were expunged at once; or private, when that was done at the motion of one of the parties.

ABOMASUS, or ABOMASUM, names which have been given to the fourth stomach of ruminating animals. It is from the abomasus, or fourth stomach of calves and lambs, that the runnet is obtained, for the coagulation of milk, or its conversion into curd. See ANATOMY.

ABOMINATION, a term employed in Scripture to denote the Hebrews, who, leading a pastoral life, are said to have been an abomination to the people of Egypt, on account of their sacrificing the animals which the Egyptians deemed sacred. The term *abomination* is likewise used in Scripture to denote idolatry, which, being frequently attended with licentiousness, is odious. Antiochus Epiphanes ordered the statue of Jupiter Olympus to be placed in the temple of Jerusalem, which commentators understand to be meant by the phrase of the prophet Daniel, the *abomination of desolation*; and the same expression employed by the evangelists, is referred to the Roman ensigns, during the siege of Jerusalem by Titus, because the representations of their gods were embroidered on them, and placed on the temple after it was taken.

ABORIGINES, in the most limited acceptation of the word, denotes a particular people in Italy, inhabitants of ancient Latium, now known by the modern name of *Campagna di Roma*. According to the opinion of St Jerome, the Aborigines were so denominated as being *absque origine*, the postdiluvian planters of the country; while others are of opinion that they were so called, as being originally Arcadians, who claimed to be born of the earth, and not deriving their origin from any people whatever. In a modern sense, it is employed to denote the original inhabitants of any country, in opposition to colonies, or new races of people from a distant region. Thus, the natives of Britain, in the time of Julius Cæsar, were the Aborigines of that country, in opposition to the Saxons and Danes, by whom it was afterwards subdued.

ABORTION, the premature expulsion of the fœtus. Solon and Lycurgus, the celebrated legislators of Greece, strictly prohibited every attempt to procure abortion. The practice was common among the Romans; and it is doubted whether any prohibition existed against it previously to the time of Antonine and Severus, who made it criminal only in the case of a wife procuring abortion, from resentment, to deprive her husband of the comfort of children. The punishment annexed was only temporary banishment. In the present day, it is a common practice, in different parts of the world. Before the revolution in France, the crime of procuring abortion was punished with death; but since that period, the punishment is twenty years imprisonment; and it ought to be generally known, that, by an act of the British parliament, passed in the year 1803, those who are guilty of procuring abortion, in the early period of pregnancy, or before the child be quick, are subjected to imprisonment or transportation; but in the latter period, or when the child has quickened, they shall suffer death. It is scarcely necessary to add, that, in the case of a woman's death, in consequence of medicines taken for the purpose of causing abortion, those who administer them are chargeable with the crime of murder; for this, it is obvious, must be considered equivalent to the exhibition of poison.

ABOUKIR, a small town between Rosetta and Alexandria, in Egypt; is supposed to be the ancient Canopus. It is built upon a rock, and seems to have been formerly an island. Aboukir is an inconsiderable place, has few inhabitants, and scarcely any trade; but it is celebrated on account of the splendid victory gained by Lord Nelson over the French fleet on the 1st of August 1798, and by a severe engagement between the Turks and French, which took place in July of the succeeding year, when Buonaparte obtained possession of the peninsula. It was taken by the British in 1801. Aboukir is 12 miles N.E. from Alexandria.

ABRAM, or ABRAHAM, in Scripture history, the father of the faithful, was the son of Terah, and the tenth in lineal descent from Shem, the son of Noah. It is supposed that he was born in the city of Ur in Chaldea. Accompanied by his father, Abraham left that city, and resided at Haran, in Mesopotamia, where Terah died. He then received the divine command to go to Palestine, which was inhabited by the Canaanites; and the promise was then made to him, that his descendants should become a great nation, and that a seed should be raised up to him in whom all nations of the earth should be blessed. Under the firm belief of the accomplishment of this promise, he took with him his wife, his family, and cattle, and settled in Canaan. He died at the age of 175 years, and was buried in the cave of Machpelah: but for the particular detail of the life of this patriarch, we must refer to the Scripture narrative by Moses. A great deal of traditionary history has been related of Abraham, little of which is worthy of notice; and it has been added, that he was profoundly skilled in many sciences, and was the author of several books; that he taught the Egyptians arithmetic and geometry, and instructed the Phœnicians in astronomy.

ABRASAS, or ABRAXAS, a mystical, or cabbalistic word, composed of Greek letters, which, according to the Grecian mode of numeration, are equivalent to 365. This word is also supposed by some to be the name of the supreme god of the Basilidian heretics; and that they wore gems, by way of charm or amulet, on which this word was engraven. According to Basilides, the founder of this sect, there are 365 heavens between the earth and the empyrean, to each of which an angel or intelligent being, by whom it was created, is appointed. Each of the angels was created by the superior angel,—thus ascending to the Supreme Being, or the first Creator of all; but of the origin and use of these gems, which have greatly occupied the attention of antiquarians, their opinions are quite unsettled.

ABRIDGMENT, in *Literature*, the reduction of a book into a smaller compass; is an occupation of great utility, both to the abridger himself, to enable him to become master of the contents of any work, and for the purpose of communicating to the public the more essential parts of any subject. The method of reducing the bulky works of the ancients came into general use about the fifth century. Some of those who were engaged in this occupation were satisfied with a mere abridgment of their authors, whose expressions were employed, or only inconsiderable alterations adopted. Some composed abridgments by extracting the materials from various authors, and clothing them in their own language; while others consulted several authors who wrote on the same subjects, took passages from each, and uniting them, formed a new work. The best maxims, the characters of persons, descriptions, and other topics which appeared most interesting, were preserved; and in this way, it is probable, many valuable fragments of antiquity have been rescued from oblivion.

The art of abridging is peculiarly useful, either in committing to memory, or in writing down what is delivered by public speakers; and for this purpose it is necessary that the plan and arrangement of the subject should be well understood, and then it will not be difficult to recollect and note down the leading parts of the discussion, and the arguments which are employed in support of the different topics and positions which are advanced. The abridger may then extend it in the form of a discourse, dressed in his own language, and thus materially improve his talents in composition. In abridging any printed work, the first thing to be attended to is its precise object, and then to study those parts of it which are most essential in attaining the object which the author had in view. When the abridger has reached these points, he is qualified to retrench redundancies, to clear up ambiguous expressions, and even to produce a more perfect work than the original.

ABRUZZO, a province of Naples, and anciently the country of the Samnites, a brave people, who were long distinguished for their successful hostility to the Romans. The Adriatic forms the boundary of this province on the north-east; and the river Pescara divides it into Abruzzo Citerior and Ulterior, of which Aquila and Chieti are the chief towns. The soil in many places is rich and fertile; rice, wheat, and other grain, wine, oil, fruit, and saffron, are abundant; but the want of roads and commodious harbours renders exportation difficult, and excludes the inhabitants from the advantages of an exchange of commodities for their redundant productions, so that they are very generally in great poverty and wretchedness. Liquorice is cultivated on the coast, and the produce of wool is considerable, from extensive flocks of sheep, which thrive well on the pastures of the more elevated regions in summer, and of the warmer plains in winter. A large extent of the province is mountainous and rugged, covered with thick woods, which afford shelter to numerous wolves and bears, whose predatory incursions, during the severity of winter, are often exceedingly destructive. The lynx or tyger-cat, and deer, are enumerated among the wild animals. The manufactures extend only to coarse woollen stuffs and pottery ware, the latter of which finds a ready market in Germany.

To the southward of Abruzzo Ulterior, lies the ancient lake *Fucinus*, now called *Lago di Celano*; and the canal or drain, for carrying off its superfluous waters, traverses this province. This canal was constructed by the Emperor Claudius at an immense expense, 30,000 men being employed for the period of eleven years. The extent of this canal is three miles; part of it is open, part is supported by masonry, and part is dug through a mountain. This lake, which exceeds forty miles in circumference, is described by travellers as a most beautiful and romantic expanse of water; but in consequence of the numerous torrents from the surrounding mountains, which are often swoln with rains or melted snow, its banks were frequently subjected to destructive inundations; and as great part of the canal is now filled with rubbish, the neighbouring plains are still liable to the same calamity.

ABSALOM, in *Scripture history*, the son of David, king of Israel, and the brother of Tamar, who was ravished by Ammon, their elder brother, by a different mother. Two years elapsed before an opportunity offered of revenging this injury, when the assassination of Ammon was perpetrated at a feast prepared by Absalom. To avoid his father's resentment, he fled to Talmai, king of Geshur, and remained with him three years; and he was no sooner restored to favour, than he stirred up the Israelites to revolt against David. Absalom's army was defeated; and in his flight through the wood of Ephraim, his hair was entangled in the branch of an oak tree, where he hung till Joab came up and pierced his body with three darts, although David had issued the most express orders to spare his life. When he heard of the fate of Absalom, he was thrown into the deepest affliction, and the pathetic lamentations which he uttered for the death of his rebellious son forms part of the sacred narrative.

The weight of Absalom's hair, which is stated at "200 shekels of the king's weight," has been a fertile subject of criticism among commentators, arising, no doubt, from the uncertainty of the precise weight of the shekel. According to the estimate of some, it was 6¼ pounds; by that of others, it is increased to the enormous quantity of 12½ pounds; while others reduce it to five ounces.

ABSCESS, in *Surgery*, a cavity containing purulent matter, so denominated from a word which signifies to *separate*, because parts naturally united, in consequence of injury or disease recede from each other by the secretion and accumulation of matter. See SURGERY.

ABSCISSA, or ABSCISS, is the segment of the diameter of a conic section, between its vertex and an ordinate. See CONIC SECTIONS, under MATHEMATICS.

ABSIMARUS, a short-lived emperor of the East, who owed his elevation to one of those sudden revolutions which are effected by the power of an army in unsettled states. He was proclaimed by the soldiers in the year 698. He succeeded Leontius, who, after mutilation, by having his nose and ears cut off, was thrown into a monastery. Justinian II. who had been dethroned by Leontius, aided by the Bulgarians, attacked and took Constantinople, and made Absimarus prisoner. Having both usurpers in his power, he commanded them to be loaded with chains, and while he enjoyed the barbarous satisfaction of standing with a foot on the neck of each of his insulted rivals, for the space of an hour, in the presence of all the people, the air resounded with exclamations from the fickle multitude, who sung, "Thou shalt walk on the asp and the basilisk, and tread on the lion and the dragon." After this cruel treatment, the dethroned monarchs were beheaded in the year 705.

ABSINTHIATED, a term used by older medical writers, and signifying a substance impregnated with wormwood, as wine or spirits, hence called wormwood wine, &c. Infusions of this kind are beneficial in cases of indigestion.

ABSOLUTE, in its general meaning, is expressive of something which is free or independent, which does not subsist in virtue of any thing as its cause, in which sense God is said to be absolute. The same word is employed to denote what is unfettered by conditions or limitations, as in the phrases *absolute obedience, absolute promise*.

ABSOLUTE NUMBER, in *Algebra*, is any pure number in an equation, or the known quantity which forms one of its terms; as in the equation $2x + 12 = 24$, the numbers 12 and 24 are absolute.

ABSOLUTION, in the *Civil Law*, is the sentence pronounced, after hearing the evidence by which a person charged with a crime is declared innocent. According to the forms of the Roman judicatories, when the pleadings were finished, three ballots were delivered to each of the judges: One was marked with the letter A. signifying *absolvo*, I absolve or acquit; another with the letter C. signifying *condemno*, I condemn; and the third, with the letters N. L. signifying *non liquet*, it is not clear, or, the case is doubtful; and the sentence pronounced corresponded to the majority of votes of condemnation or acquittal.

ABSOLUTION, in the *Canon Law*, is that act by which the priest, according to the forms of the Roman Catholic church, pronounces the remission or forgiveness of the sins of those who make full confession, and give evidence of sincere repentance.

ABSORBENT *Medicines*, are such substances as, if taken into the stomach, are supposed to have the property of combining with or absorbing acrid or redundant matters, which are preternaturally secreted in the digestive organs; such are, testaceous powder, or chalk, or crabs' eyes, or magnesia; and certain substances are applied externally to the skin, with a similar intention of absorbing acrid humours which are exuded in cases of inflammation.

ABSORBENT *Vessels*, or ABSORBENTS, in *Anatomy*, are minute and transparent vessels which have been detected in animal bodies, and which take up or imbibe fluids which come in contact with them. These vessels are divided into *lacteals* and *lymphatics*. The lacteals open on the internal surface of the stomach and intestines, and absorb the chyle or nutritious fluid, and convey it to the mass of blood, to repair the waste which it sustains in the course of the circulation. The lacteals derive their name from the fluid which they contain having a milky appearance. The lymphatics are so denominated, from

Absorption.

the lymph, or pellucid fluid, which they absorb and convey from the cavities and surface of the body. See ANATOMY and PHYSIOLOGY.

ABSORPTION, in *Physiology*, the function of the absorbent vessels, or the power by which they imbibe and propel their peculiar fluids. Some have attempted to explain this function, on the principle of capillary attraction, while others ascribe it to the pressure of the atmosphere, or to suction, which is only a different mode of expressing the same fact, since it depends on the same pressure. See PHYSIOLOGY.

ABSORPTION, in *Chemistry*, is that power or property, which some bodies possess, of absorbing or attracting others, in the state of liquid or elastic fluid. Thus, a sponge absorbs a large proportion of water; a piece of wood, or porous stone, exhibits the same property; water combines with different airs or elastic fluids, in proportion to its temperature; and fresh prepared charcoal greedily absorbs air or water. In some of these cases, the absorption is to be considered as a mechanical rather than a chemical action. But the process of slaking lime presents one of the best examples of the absorption of a liquid by a solid body, and is, besides, a case of chemical combination. Here a large portion of water unites with the lime, which falls down in the state of dry powder; and, during the process, great heat is produced in consequence of the evolution of the caloric, or heat which is necessary to retain the water in the liquid form. See ATTRACTION, under CHEMISTRY.

ABSORPTIONS *of the Earth*, an expression which has been employed by naturalists, to denote the sinking of extensive tracts of land, in consequence of subterraneous convulsions. Such absorptions are by no means uncommon in countries which are subject to earthquakes; and few, indeed, which are visited by calamities of this kind, are entirely exempted from their dreadful effects. Examples are not wanting, both in ancient and modern times. Pliny mentions, that the town of Curetes, with the mountain on which it stood, was entirely swallowed up. He records also a similar fate of the city of Tantalus, in Magnesia; and afterwards of the mountain Sypilus. Galanis and Gamalis, celebrated towns in Phœnicia, and the lofty promontory of Phegium in Ethiopia, disappeared, and left not the slightest vestige of their existence.

In more modern times, Picus, a lofty mountain in one of the Molucca isles, which was seen at such a distance as to be a useful landmark to sailors, was shaken by an earthquake, and sunk in a moment. An extensive lake, whose shores marked the limits of the base of the mountain, now occupies its place. In the year 1566, an entire province, in a mountainous district of China, was swallowed up, with all its inhabitants, and what was formerly dry land became an immense lake. Those parts of South America, in which earthquakes prevail, have suffered greatly from similar calamities; and in 1692, during a dreadful earthquake, great part of the town of Port-Royal, in Jamaica, with a large proportion of the inhabitants, sunk into the ocean.

The fall of mountains has been ascribed to a similar absorption of some part of the subterraneous materials which support their base. In the year 1727, a mountain in the south of France, forming part of the chain of the Cevennes, fell, with a tremendous crash, into the valley below, and in its progress overwhelmed an entire village, the inhabitants of which fortunately escaped, in consequence of being at some distance, celebrating a rural festival. But the most memorable calamity of this description took place in Switzerland, on the 3d September 1806, when the Spitzberg, a projecting cliff of the mountain Rosenberg, was suddenly precipitated from the height of 2000 feet, and overwhelmed in its ruins five or six villages, with nearly 2000 inhabitants.

Abstinence.

ABSTINENCE, in its general meaning, is the act of avoiding or refraining from something to which there is a strong natural or habitual propensity. But this word is employed particularly to denote a spare diet, or denying the appetite its full indulgence in certain kinds of food to which it has been accustomed. Many remarkable effects in promoting health, and protracting life, and some wonderful cures recorded by the older medical writers, are ascribed to abstinence. But it must be observed, that the abstinence here alluded to, is confounded with moderation and regular habits of life. Such, for instance, is the example of Cornaro, a noble Venetian, who had lived in dissipation and luxury till the age of forty, when he was seized with a violent disease, which threatened his life, and who, by the mere effect of abstinence, not only recovered, but enjoyed almost unbroken health to the great age of 100 years. But this, and similar cases on record, ought perhaps to be considered in no other light than as striking examples of the beneficial effects of temperance and regularity.

Abstinence is more frequently applied to those cases of animals which are either totally deprived of food, or live on a very small portion. Many animals live a long time under a total privation of food: Such, for instance, are those which become torpid on the approach of winter; but in these cases the animal functions are in a great measure suspended, and are only restored to their former vigour by the genial warmth of spring. The most remarkable examples of abstinence, or total privation of food, are found among the cold-blooded animals, as frogs and toads, serpents, lizards, and insects. A rattlesnake has lived many months without any food, whilst its health and vigour seemed in no degree diminished. Dr Shaw mentions, that two Egyptian serpents, which had been kept five years in a bottle, closely corked, had just cast their skins when he saw them, and were as brisk and lively as when they were first taken. Experiments have been made by Redi, Leuwenhoek, Buffon, and other naturalists, to ascertain how long different animals could live without food. A spider lived eight months; a beetle, three years, when it escaped; a toad fourteen months, and, in another instance, eighteen months; a land tortoise eighteen months; several dogs lived thirty-six days; a wild cat twenty days; a civet cat ten days; a badger a month; an eagle twenty-eight days; and wild pigeons twelve and thirteen days. Even human beings have afforded astonishing examples of living a considerable time under a total privation of food;

as in cases of shipwreck, when the crew had been thrown ashore on desart islands, or when persons have been buried under the snow, or confined in places altogether inaccessible.

Abstinence, as a religious observance, may be considered as either partial or temporary. It is partial, as in the case of the Jews, who abstained from particular kinds of food, according to the ordinances of their law; and on certain days of the week, as well as during the period of certain festivals, the Roman Catholics abstain from eating flesh. On the other hand, during some of the religious festivals among the Mahometans, a temporary abstinence from food is ordained, and they are strictly enjoined to observe it from sunrise to sunset. A similar abstinence was observed among some of the ancient sects of philosophers. The Pythagoreans were forbidden the use of animal food, except what remained of the animals offered in sacrifice. Their drink was pure water, or only a small portion of wine, in which they might indulge in the evening.

ABSTINENTS, a heretical sect which arose in France and Spain about the end of the third century, and are supposed to have derived some of their tenets from the Gnostics and Manicheans. They disapproved of marriage, and prohibited their followers from the use of flesh meat.

ABSTRACT, in its general acceptation, denotes something which is considered apart, or separated from other objects with which it is naturally conjoined.

Abstract, in *Literature*, is a sketch or compendious view of any subject treated in a larger work, but shorter and more condensed than an abridgment.

Abstract, or Pure Mathematics, considers magnitude or quantity generally, or without reference to any particular magnitude or number, as in arithmetic and geometry; and is opposed to mixed mathematics, or the application of mathematical science to the investigation of material objects; as, for example, when the properties of air and light are examined, constituting the sciences of Pneumatics and Optics.

Abstract Numbers, are assemblages of units, considered independent of any reference to particular objects; thus, 4 is an abstract number; but 4 trees is a concrete number, because it is conjoined with certain specific objects.

Abstract Terms, are words which express certain properties or qualities, considered apart from the objects in which they reside; as, brightness, redness, hardness.

ABSTRACTION, is that operation of the mind which is occupied in considering one property or quality of objects separate from others with which it is conjoined in nature. Thus, in the expressions, *red coat*; *red rose, red pink*, a certain quality, denoted by the term *red*, is said to belong to each of these objects. But, by the power of abstraction, the mind separates this property from individual objects, and considers it under the general term *redness*. In the same way, the mind proceeds in arranging and distributing objects possessing some common properties into groupes or divisions, according to colour, figure, density, or degrees of hardness, or some other common property, by which the groupe or division to which distinctive appellations are given, is characterized and known. This is called *generalization*, and is a very important mode of procedure in the acquisition of knowledge; for by this means the labour of investigation is greatly abridged and facilitated. See Logic and Metaphysics.

ABSURDUM, Reductio ad, *leading to an absurdity*, in Geometry, is a mode of demonstration resorted to by mathematicians, to prove the truth of a proposition, by shewing that the contrary is impossible, implies a contradiction, or leads to an absurdity.

ABTHANE, an honorary title of distinction, which existed in the earlier periods of Scottish history, the nature of which seems to be imperfectly understood by antiquarians. According to one explanation, the nobles, or *thanes*, held a middle rank between *abthanes* and *underthanes;* the first possessing a superior, and the last an inferior dignity. But according to another view, the thane, which, in the Saxon language, signifies, *minister of the king*, was appointed to attend to certain rights which the king reserved over lands granted to a bishop or abbot; while the abthane was the minister, or steward, of the ecclesiastical possessor.

ABUBEKER, or Abu-Becr, the immediate successor and confidential friend of Mahomet, was the first convert to the new faith, and his only companion in his flight from Mecca to Medina. He was originally named Abdulcaaba, *servant of the temple.* This was changed to Abdallah, or, *the servant of God;* and when the prophet married his daughter Ayesha, he assumed that of Abu-Becr, the *father of the virgin.* The new religion was in imminent danger of perishing on the death of its founder; an event which was thought by many of his followers to be impossible. But Abubeker, with the assistance of Caled, an able general, prevented a total revolt, and either reduced to submission, or punished with death, all who disputed or opposed his authority. His prudence and moderation powerfully checked the fanaticism of the disciples of Mahomet, after that prophet's decease; and having restored tranquillity within his own dominions, he carried his victorious arms into Syria. His celebrated general, Caled, laid siege to Damascus; and on the very day on which it capitulated Abubeker died, in the 64th year of his age, and 13th of the Hegira, and 635 of the Christian era.

Abubeker was distinguished as caliph (the name which all his successors assumed) for his prudence, equity, and moderation; for his indifference to riches and honours; his liberality to the poor, and to the military, among whom he divided his revenue. He collected the detached revelations of Mahomet, to which the Arabians gave the name of *Almoshaf*, or the book, the transcript of which was deposited with Hassa, the widow of Mahomet.

ABULFARAGIUS, Gregory, a native of Malatia, a city of Armenia, was born in 1226. He followed the profession of his father, which was that of a physician, but was afterwards created bishop of Guba, by Ignatius, patriarch of the Jacobites. He was a voluminous writer; but his Epitome of Universal History, which was published in 1663 by Dr Pococke, with a Latin translation, is considered as the most learned and valuable of all his works. He was well acquainted with the Greek, Syriac, and Arabian languages; and he was panegyrised by his cotemporaries as "the king of the learned, the phœnix of the age, and the crown of the virtuous." He died in 1286, in the 60th year of his age.

ABULGHAZI, BAYATUR, a prince of the Tartars, descended from the famous Jenghiskhan, was born in the year 1605; and having passed through a long train of disasters and misfortunes, he mounted the throne of Karuzm in 1645. During a reign of twenty years, by the courage and vigour of his administration, he made himself respected and feared by his enemies. This prince is one of the few recorded in history, who have laid aside the pomp of power, to descend into the peaceful quiet of retired life. In 1665, he resigned his sceptre into the hands of his son, and devoted the remainder of his days to literary pursuits. In his retirement he commenced a work, the genealogical history of the Turks; but his labours were interrupted by death, and the work was completed by his son and successor. It is written in the Turkish language; and being esteemed an authentic history of the Turks and Tartars, has obtained some degree of celebrity. It has been translated into many of the European languages.

ABUNDANT NUMBER, in *Arithmetic*, is a number the sum of whose aliquot parts exceeds the number itself. Thus 12 is an abundant number, because its aliquot parts or divisors, 1, 2, 3, 4, and 6, added together, are equal to 16. It is opposed to a *deficient* number, the aliquot parts of which, taken together, are less, as 14, whose divisors or aliquot parts are, 1, 2, and 7, which added together make 10; and also to a *perfect* number, to which its aliquot parts are equal, as 6, whose aliquot parts, 1, 2, and 3, added together, are equal to the number itself.

ABYDOS, an ancient town, built by the Milesians, on the Asiatic side of the Hellespont, or Strait of the Dardanelles. This place is frequently referred to by classical writers; it is noted in history as the scene of the story of Leander and Hero; and near it was the famous bridge built by Xerxes. As Abydos commanded the passage of the straits, its possession was deemed of great importance to those who were anxious to interrupt the communication between the Archipelago and the Euxine, or Black sea. The desperate resistance which the inhabitants of Abydos opposed to the attack of Philip, king of Macedon, is almost unequalled, in ancient or modern times. When it appeared that the city must fall into the hands of the enemy, the inhabitants vowed, in the most solemn manner, that they would put their women and children to the sword, and destroy all their property, rather than submit to a foreign yoke; and when the Macedonians entered the town, the citizens had actually begun to destroy each other. The work of death was only interrupted by the interference of the victorious enemy. This event took place about 200 years before the Christian era.

ABYDOS, an ancient town of Egypt, situated between Ptolemais and Diospolis Parva, and celebrated for the palace of Memnon, and the splendid temple of Osiris. This city, which was one of the most magnificent in antiquity, was reduced to a village in the time of Augustus, and now presents a heap of ruins. Not far from the ruins is the famous tomb of Osymandes, an edifice of extraordinary magnificence, which had a portico 60 feet high, supported by a double row of massy columns. This forms the entrance to a temple 300 feet long, and 145 feet wide, the roof of which is supported by 28 columns, 60 feet high, 19 feet in circumference at the base, and 12 feet distant from each other. The walls of these spacious apartments are covered with hieroglyphics, among which appear numerous animals, birds, human figures, and some Indian divinities. This remarkable edifice contains many subterraneous apartments; but the passages have been filled up with heaps of earth and rubbish by the Arabs, in searching for treasure.

ABYLA, the ancient name of one of the pillars of Hercules, on the African side of the Straits of Gibraltar, and opposite to Calpe, the other pillar, which is situated on the Spanish side.

ABYSS, in its general acceptation, denotes something which is profound; or, from the literal signification of the word in the Greek, from which it is derived, *bottomless*. In Scripture, this word is applied to the water which God created at the beginning, with the earth, and has been translated by the word *deep*. In the New Testament, the same word, which is translated *bottomless pit*, is supposed to denote hell, and to correspond with the *Tartarus* and *Erebus* of the ancients.

ABYSS is also a term used to denote an immense cavern in the earth, in which God is supposed to have collected the waters on the third day, which, in the English version of the Bible, is translated *seas* and *great deep*. According to some of the older geological writers, this collection of waters still exists in the central parts of the earth, and has a communication with the ocean. This opinion has been opposed by others, and has been the subject of a good deal of controversial discussion. See Woodward's *Natural History of the Earth;* and Cockburn's *Inquiry into the Truth and Certainty of the Mosaic Deluge.*

ABYSSINIA, a large country in eastern Africa, bounded by the Red sea on the east, part of the kingdom of Sennaar on the north, another part of the same kingdom and Kordofan on the west, and on the south by several deserts and mountainous districts, which separate it from Alaba, Gingiro, and Adel. It lies between the 7° and 17° N. Lat. and between the 33° and 43° E. Long. from Greenwich; being about 700 British miles long, and 500 broad. The inhabitants, who are dark-coloured, but without any of the negro features, have long professed the Christian religion, though on all sides surrounded by the followers of Mahomet, and by tribes not yet emerged from paganism. To this country various other names have been applied in different periods; but the term Abyssinia has nearly altogether supplanted them; and, accordingly, those of Upper or Higher Ethiopia, Abassia, Al-Habash, Cephenia, Etheria, &c. are rarely used in modern times.

Face of the Country.—The face of the country is mountainous; to which, in a great degree, must be ascribed a moderate, and, comparatively speaking, healthy climate. Another advantage arising from this inequality of surface is the number of rivers, streams, and lakes, which essentially contribute to the fertility of the soil. These, however, are not so extensively distributed as to supply the demands of the whole of Abyssinia; but, on the whole, few countries of similar geographical situation, are less frequently visited by excessive drought. One of the ranges of mountains which traverse this region, named Taranta, is on the east of the kingdom, extending in a direction nearly parallel to the Red sea. Another occupies the centre; and, besides a third range, towards the southern boundary, there are numerous detached groupes of less elevation in the intermediate plains. These add to the picturesque aspect of the country, and are well fitted for defence. The central range is known by the name of Lamalmon; that on the south, by Ganza. The former contains the mountains of Amhara, and Semena, which, according to one author, are the most elevated in the kingdom. The latter, from the circumstance of its exhibiting a semi-circular form, was imagined by Mr Bruce to constitute part of what have been long denominated the Mountains of the Moon,—an absurd appellation, given to an immense chain, supposed, on very inadequate proof, to run across the African continent. The conformation of the mountains, in general, is imperfectly known; few persons, if any indeed, competently acquainted with mineralogy, having examined them. From their magnitude, however, their mode of arangement, the appearance of their summits, and the circumstance of granite being frequently found to constitute a part of them, there is every reason to conclude that they belong to the class of primitive rocks.

Rivers, &c.—The principal rivers are, the Bahr-el-Az-rek, Abay, Abawi, Astapus, or Blue river, as it has been variously named, and which, for reasons it is unnecessary to state here, was imagined by Mr Bruce to be the Egyptian Nile, whose origin it was the chief object of his celebrated travels to ascertain; the Tacuz, or Tacazze, known to the ancients by the name of Astaboras; the Bahr-el-Abiad, or White river, conceived to be the chief branch of the Nile; the Maleg, said by some to join the Tacazze, and by others to augment the waters of the Abawi; the Mareb, remarkable for its depth and smoothness; the Jemma, a rapid river, equal in size to the Bahr-el-Abiad; and the Hawash, and Hanzo or Hanazo, two smaller but still very considerable rivers, which run toward the Red sea, or rather the Indian ocean, not very far below the straits of Babelmandel. Of the lakes may be mentioned, the Dembea, or Tzana, of variable size according to the season of the year, but at times estimated at 60 miles long, and 30 broad; the Zawaja, one of the sources of the river Hawash, in the south of the kingdom; and Haik, which, though of smaller extent, is of sufficient magnitude to merit distinction.

Climate, &c.—The climate of Abyssinia, it will readily be supposed, from what has been already said, is much modified by the peculiarities of its surface. It is cold and somewhat unkind in the highest region; agreeable and salutary on less elevated lands; whilst in the low plains and confined vallies, much inconvenience, and no small injury, are often experienced from the prevalence of moisture or excessive heat. The range of the thermometer is between 60° and 80°, rarely exceeding in either direction, and more rarely towards cold. The appearance of ice and snow, therefore, is utterly unknown in the inhabited parts of the country; but the popular legends make mention of the supposed miraculous occurrence of white rain, and a hard transparent substance on the surface of the water, on some very particular occasions; and this description is abundantly verified, for European faith at least, by the testimony of Mr Pearce, who was long enough in Abyssinia to have an opportunity of witnessing the occasional existence of both on the top of the loftiest mountains. The seasons are not uniform, but appear to vary in their duration and periods of approach, according to the situation with respect to the mountains. This accounts for the discordance in the relations of those authors who have treated of the subject. Perhaps, also, it is proper to admit, that, as in other countries, certain disturbing causes occasionally produce variations in the commonly observed uniformity. But, on the whole, we may conclude, that there is no great difference between the seasons of Abyssinia, Egypt, Barbary, and the Syrian states.

The soil, which must be various, cannot be reckoned ungenerous; for, if the industry and skill of the people were equal to its capability, it would yield every necessary, and many of the luxuries of life, in the greatest abundance. Neglected, or mismanaged as it is on their part, nature has done her's, in no illiberal manner, singularly favouring some districts, especially those which are watered by rivers, with most luxuriant and often renewed vegetation. Wheat, barley, teff, and other grains, are amongst the alimentary products; and of these there are sometimes even three harvests in the year. The first is usually about the end of November, the second in the end of February, and not unfrequently a third succeeds towards the end of March, immediately previous to one of the rainy seasons. Besides the articles now mentioned, different districts yield cotton, linen, wax, and honey, various aromatics, abundance of fruits of the richest kinds, and many other productions, the excess of which beyond the demands of the natives answers the purpose of trade with foreign countries.

Divisions.—Abyssinia has been variously divided at different periods; but its political divisions are so liable to changes, from causes to be afterwards specified, that even the enumeration of its several provinces, as given by Mr Bruce, who visited the country in 1769, is unsuitable to its present condition. That which we are about to detail is on the authority of the more recent information of Mr Salt, who divides Abyssinia into three independent states, viz. Tigré, Amhara, and the united provinces of Shoa and Efat.

Tigré and Amhara are distinctly separated by natural boundaries, viz. the high range of mountains in Samen, which extend from Waldubha to the south of Lasta, and the course of the river Tacazze along the base of that range. The character and language of their respective inhabitants form, besides, a striking cause of distinction, which it is exceedingly improbable that political circumstances should at any time altogether subvert.

Tigré, at present the most powerful state in Abyssinia, is bounded on the north by the Bekla, Boja, Takue, and Shangalla tribes; on the west and south-west, by the mountains of Samen; and on the east, south-east, and south, by the Gala, Doba, and Danakil tribes. It comprehends about 4° in Lat. and as much in Long., and is divided into several provinces. The central province is Tigré proper, from which the denomination of the whole is derived; and it is bounded on the north by the Marat, on the east by Agami, by Shiré on the west, and the river Warre on the south. In general it consists of ranges of hill-forts, intersected by deep gullies and well cultivated plains. Agamé, to the east of Tigré proper, is a rich and level country, considerably elevated above the sea. Its eastern frontier, which is the high ridge of mountains extending from Senofé to Taranta, its strong holds on the Taltal, and its vicinity to the Salt-plain, which is an object of so much consequence to Abyssinia, contribute greatly to the importance of this province. On the south of Agamé are the mountainous districts of Derra, Asme, Womburta, Desa, Muntilla, and Monos, forming part of the province of Enderta, which comprises also the territories of Moculla, Dirbah, Gambela, Upper and Lower Gibba, Wazza, Saharti, and Giralta. Antalow, the capital of Enderta, is well situate for defence against the attacks of the Galla, from which Abyssinia has so often suffered of late years: it has accordingly been chosen for the residence of the Ras or sovereign of the province, though Chelicut in its neighbourhood, which may be considered as a country seat, be his favourite place of abode. A long and narrow region, running in a direction from east to west, called Wojjerat, lies to the south of Enderta. It is said to be covered with forests, to abound in beasts of prey, and all kinds of game, and is much celebrated for its white honey. The small low district of Wofila, where the adventurous Galla have succeeded in intermixing with the native Abyssinians, is to the south of Wojjerat. In the same direction lies the almost inaccessible province of Lasta, noted for its mountains and soldiery; and to the north lie the two provinces of Bora and Salowa, which much resemble it in hilly aspect. Still farther to the north is Avergale, a narrow flat country, extending 50 miles along the eastern side of the Tacazze. On the western side of this river is the province of Samen, whose mountains are reckoned to stretch about 80 miles from north to south. Between the most northerly part of this extensive range and Tigré proper, is Temben, a valuable province, divided into several districts, each of which has its separate chief, or Shum, as he is called. It has been noticed, that the houses in this province, and in Avergale, resemble the ancient Egyptian temples, and are usually built without mortar. North of Temben is the province of Shiré, forming a sharp angle with the Tacazze, by which it is separated on its western side from the beautiful and fertile districts of Waldubha and Walkyt. The north-east province of Tigré is commonly called the kingdom of the Baharnegash, and comprises a great many districts, all of which are ruled by different chiefs.

Amhara, the second division of the kingdom, is no longer subject to it, having been subdued by the Galla, between whom and the people of Tigré there exists a state of perpetual hostility. Since their conquest of Amhara, the Galla have in great measure adopted the more civilized manners, the dress, and mode of living of the Abyssinians. The name of Amhara is still retained, probably on account of the language prevailing there. It comprehends the provinces of Begemder, Menna, Belessen, Foggora, Dembea, Tcherkin, Knara, Tchelga, Maitsha, Gojam, and Damot. Some of these are extremely rich, and at one time, indeed, constituted the most important part of the kingdom. Thus, Gondar, the capital, is situate in Dembea, one of these provinces; but the king, who still resides there, is almost entirely neglected, having but a few attendants, and keeping up a mere resemblance of the ancient dignity of his office.

Of the united provinces of Shoa and Efat, which form the third, or southern division of Abyssinia, and which are now entirely separated from the others by the Galla, the former is described as a high track of land, running north and south, and throwing off a number of small streams; and the latter, which is on a lower level, is celebrated for its fine pasturage and fertile vallies. It is said also to contain many large towns, and an immense number of monasteries. From all the accounts which Mr Salt received, he was inclined to think that Ethiopian literature might be found in a more flourishing condition here than in any other part of Abyssinia, and that the inhabitants retain more of the ancient customs and peculiar manners of their forefathers than either of the other two states.

The natural history of Abyssinia presents an interesting variety of objects.

Quadrupeds.—All the common domesticated quadrupeds are found in abundance. The Galla oxen, or Sanga, are remarkable for the size of their horns, some of them amounting to four feet in length, and to upwards of twenty inches in circumference at the base. Mr Bruce conjectured, that this peculiarity was the effect of disease, and that great pains were taken to encourage it. But in this he was entirely mistaken, as the observations of Mr Salt have shewn. Several specimens seen by him were in perfect health, three of them indeed so exceedingly wild that it became necessary to shoot them. The horns of one have been deposited in the Museum of the College of Surgeons in London, and a still larger pair adorns the collection of curiosities belonging to Lord Valentia at Arley Hall. The animal is not of greater size than is common to the genus; its colour is not peculiar; and both male and female are provided with these gigantic ornaments.

Wild animals are extremely numerous. This seems to indicate, either the unimproved state of the country, or the frequency of wildernesses and thick forests. Lions are found in the sandy districts bordering the Tacazze; but as the killing of one of them confers a certain degree of honour, it is probable they are not in great numbers. There are several species of the leopard tribe, some of which are said to be very fierce, and to prove destructive to children, and even men, occasionally carrying them away, if found asleep or unprotected. Hyænas exist in vast numbers, and are exceedingly ferocious. The howling of this animal is very peculiar. It consists of three distinct deep-toned cries, succeeded by a few minutes silence, when they are repeated.

Wolves, foxes, and jackals, as well as several species of lynx, are common; antelopes, and wild goats of various kinds, abound in some districts, with wild boars, porcupines, hares, squirrels, rats, &c. Elephants are met with in all the forests which border on Abyssinia. They are hunted for their teeth, by the Shangalla, a tribe of negroes to the north of Tigré. The wild forests of Wojjerat are frequented by a species of rhinoceros having two horns. These constitute an article of trade in the east, where they are used as handles for swords and daggers. The skins are employed for shields.

The buffalo is common in some parts of Abyssinia. That singular animal, the giraffe, or camelopard, is occasionally seen; but his shyness and timidity confine him to the most unfrequented parts of the country. His skin is an article of barter; and the hair of the tail is converted into an instrument for brushing away flies which are so troublesome in the hot season. The zebra and wild ass are found in the southern provinces. The mane of the former is much sought after for making a sort of collar to adorn the war horses of the chiefs; but its scarcity is probably the reason why only a few of the principal men have the privilege of wearing it. The hippopotamus and crocodile are found in the large rivers. The latter being in great numbers, and often of an enormous size, justly excite the dread of the natives at the thought of bathing, or even going near the water, unless with the utmost precaution to avoid danger from their attacks. Mr Salt had a good opportunity of proving the impenetrability of the hide of the former animal to common musket balls. Several shots were fired at one of them, and appeared to strike him, as was believed, from his angry-like noise and suddenly plunging deep into the water. Shortly afterwards, however, he rose again, without seeming to be hurt; and though another charge was made on him, there was no reason to think that he received any material injury.

Birds.—Abyssinia is plentifully supplied with birds, and their variety is very considerable. Mr Bruce has given a description of two belonging to the falcon genus; one of these he denominated the Golden eagle, by way of distinction. Dr Shaw ranks it among the vultures, terming it the "Bearded vulture." Mr Salt again, from its general appearance, and the great vigour and animation which it displays, inclines to class it with the eagles, calling it the African bearded eagle. Of one shot by him, the extent betwixt the tips of the wings exceeded eight feet. In addition to the second species named by Dr Shaw, the Occipital eagle, and which is rare in the country, there is a third, not before noticed, which Mr Salt proposes to designate by the name of the "Abyssinian white-breasted Lanner," the whole of its breast being of a clear white colour. It is about the size of a common falcon; its feet and beak are of a blueish tint, and its general colour is a deep brown, verging to black. This bird is held in high veneration by the natives, who will on no account suffer it to be killed. From several superstitious notions concerning it, and its resemblance in form to a figure he frequently met with in the hieroglyphics in Egypt, Mr Salt conceives it to be a species of the hawk, venerated by the ancient inhabitants of that country. Immense flocks of vultures are to be seen in Abyssinia, especially in the rear of an army, which, either by instinct or experience, they appear to expect will supply them with provisions; in this, generally, they are not disappointed. By the beneficent order of nature, these ravenous creatures feast on the remains of the slaughtered cattle, and the bodies of the slain and diseased soldiers, which would speedily, in such a climate, render the atmosphere destructive to animal life. At other times, and in other places, they feed on shell-fish, the wild beasts which have fallen by the hands of the hunter, or such smaller animals as their own strength or ferocity, stimulated by hunger, can overcome. The ostrich is somewhat rare. Herons are common, as well as numerous species of water-fowl; and the whole country is said to abound with red-legged partridges, quails, snipes, lapwings, &c. &c. Only one species of parroquet has hitherto been discovered. Pigeons, larks, and thrushes, are abundant.

We may now notice some of the less known, or, till Mr Salt's time, non-descript birds. *Bucco Saltii*, a new species so named by Lord Stanley, who has contributed notes to Mr Salt's appendix, in honour of that traveller as its European discoverer. This bird bears some affinity to the doubtful barbet of Latham, but may be distinguished from it. The length is about seven inches. Its bill is of a blackish horn colour, rather more than an inch in length from the gape to the tip, and about three quarters of an inch thick at the base, with two notches in the edge of the upper mandible, and a sort of indentation in the lower, but without any channel on the bill as in Latham's bird. The general colour of the plumage on the body is black; but the whole of the face, from the crown, round by the eyes and the ears, as far as the breast, is bright red; the wings are dusky; except the primaries, the quills are margined with yellowish green; and the legs and claws are dark. This bird, like the common woodpecker, clings to the branches of trees. The *Certhia Tacazze*, or splendid creeper, is one of the most beautiful birds of the kind. The head, neck, breast, upper part of the belly, the back and rump, the upper coverts and bend of the wing, exhibit a metallic lustre of the greatest brilliancy, partly green, partly purple; whilst the wings, which are dusky, have an edge of deep blue, and the lower part of the belly, the legs, and claws are black. The tail is of a bluish-black colour, but with large edges of a bright steel blue, and would be round in shape, did not the two middle feathers exceed the rest in length, nearly two inches. This bird is eight inches and three quarters in length; and its bill, which is much bent, and of a black colour, is an inch long. The *Tanagra erythroryncha*, or red-billed tanager, is the name given by Lord Stanley to a bird, of which Mr Salt saw vast numbers, especially wherever there were droves of cattle. It resembles the African beef-eater, in size, the arrangement of the feet, and the general colour of the plumage. The peculiarity in the habit of this bird is his feeding on the backs of cattle, whence he picks out a species of grub, engendered there during the hot weather, and which, without his friendly appetite, would prove extremely distressing. The *Merops furcatus*, or fork-tailed bee-eater, is above nine inches in length; has a black bill, about an inch and a half long; is, in general, of a bright yellow-green colour, but in some lights shews a golden, and, in others, a chesnut tinge; the chin and throat are bright yellow, edged with a line of bluish-green, and below the latter there is a straight bar of ultra-marine blue; the under parts of the body, and the tail coverts, are of a bluish-green. The tail, as the name implies, is forked, and the legs are weak, and dusky, with a reddish tinge. A list of more than 60 rare birds, in Mr Salt's publication, testifies the richness and variety of this department of Abyssinian natural history.

Insects.—Of the insects found in this country, those most requiring notice are, a species of fly called *tsaltsalva*, or tlatsalva, and the locust. The former, though little larger than a bee, is extremely formidable. Fortunately he is rarely encountered, and is principally confined to places where there is a black loamy soil. The wound he inflicts is extremely difficult to heal, and often gives rise to inflammation and gangrene, ending in the death of the sufferer. Mr Salt has completely confirmed the previous reports concerning the destructive powers of the locust. During his stay in an island on the coast of the Red sea, a flight of these insects, in a few days, destroyed nearly half of its vegetation; and he had convincing evidence, that it was no unusual thing for them to lay waste very extensive tracts of land. In addition to what Drs Russel and Shaw, and other writers, have said, as to these creatures being sometimes eaten in different countries, this gentleman informs us, that the wandering tribes of Yeman and Dankali commonly use them as food,—first of all broiling them, then separating their heads from their bodies, and devouring the latter, in the same manner as Europeans eat shrimps and prawns. This is certainly a suitable retaliation. But it is surpassed by what they experience from bustards, lapwings, and other birds, which contrive, in a summary way, to swallow them without any culinary or decapitating operation.

Fishes, &c.—We have no satisfactory account of the fishes found in this country; and, according to Mr Bruce, there are not many serpents, as had often been reported before his time. Of the individuals of the latter class, we may mention the *boa* snake, which is sometimes found in the low country of Abyssinia, and a species of horned viper, called *cerastes;* but the descriptions of them, and of the mode of incantation, as it is called, which has been practised on the latter, will be noticed in our natural history of those animals.

Plants.—The geographical situation of Abyssinia, its many local advantages, and the differences of soil and climate which it presents, secure to it the greatest beauty, and most abundant variety of vegetation. Indeed, nearly every plant, which requires either a very low, or a very elevated situation, great warmth and moisture, or a cold and arid soil, may be expected to adorn it. Fruits, flowers, and aromatics, are produced in the greatest perfection; and to these must be added a number of plants, which ingenuity has made subservient to the necessities and comforts of our species, or experience has ascertained to prove serviceable in alleviating or removing disease. But we could not presume to enter upon a specification of individuals; for Mr Salt, in his list of new and rare plants, collected during his stay here, enumerates more than a hundred species above what Mr Bruce had observed.

Both Mr Bruce and Mr Salt, who seem to have possessed a taste for natural scenery, were struck with the general luxuriance and beauty of this country. They have, accordingly, written under the evident impulse of an excited fancy, so as to produce no small degree of interest and pleasure in the reader. Perhaps, then, we could not do greater justice to this part of our subject, or, indeed, to the account of Abyssinia in general, than by giving a view of the most striking objects that were presented to them. Mr Bruce's work, however, has been so long before the world, and is so universally read, as to render any such labour, with respect to it, unnecessary. A few notices, therefore, are all we shall derive from it; but of Mr Salt's more recent publication, we shall avail ourselves in an ampler manner. The following abstract will serve also to introduce, and connect together, all the accounts which it is necessary to detail respecting the manners and customs of the people.

Bruce's Journey.—Mr Bruce left Arkeeko, a town near Masuah, or Massowa, on the 15th of November 1769, intending to proceed to Gondar, the capital of Abyssinia. Having changed his course from south to west on the 17th, he arrived, on the same day, at a range of mountains, over which he could find no other passage than what had been produced by torrents of water, which often, in this climate, come on with such rapidity and force as to prove highly alarming, if not dangerous to the traveller. Till the 20th, his journey was either along one of these, or on the banks of a small river, well shaded by sycamore trees, some of which were above seven feet in diameter. On that day, he reached the mountain of Taranta, which presented still greater difficulties than he had yet experienced. The ruggedness of the path, the frequent occurrence of immense gaps or fissures, occasioned by the excessive rains, and the obstructions produced by large fragments of rocks which had tumbled down from their original connexions, would have been sufficient to deter any less spirited adventurer. The eye was often delighted, however, in the appearance of trees, especially on the lower and middle regions; they were chiefly the Kolqual, olive, and cedar, which, in any situation, would afford a pleasing effect: And, on the top, a village of shepherds, flocks of sheep, and cattle of various kinds, some of them of a very beautiful white colour, besides a plain, on which wheat had been sown, administered the comfortable thought, that, even here, the liberal hand of nature had distributed the marks of her indulgence and providential care.

The western descent was equally rugged and difficult; but, on approaching the town of Dixan, the road considerably improved. Dixan, which is the first town in Abyssinia on the side Mr Bruce entered, is situate on the top of a hill of a conical shape, surrounded by a deep valley, and having no other access than by a path which winds round. Between Dixan and Adowa, lay a fertile and tolerably well cultivated country, producing several kinds of grain, and a variety of trees and flowers. Adowa, once the capital of Tigré, did not contain above 300 houses, but it occupied a large space, as the houses were generally encircled with plantations of the wanzey tree. It is on the declivity of a hill, and is watered by three rivulets. The houses are of stone, cemented with mud, the use of lime being almost confined to Gondar. The town of Axum, in its neighbourhood, once the capital of the empire, justly merited his next attention, on account of its former grandeur, and of the ruins, which are still contemplated with veneration. Siré, the next town he visited, is larger than Axum, and is said to contain about 600 houses. The intervening country has a very fine appearance; and a considerable part of the road lay over the remains of a magnificent causeway. Siré was noted for a cotton-cloth manufactory. On leaving this place, he traversed an extensive plain, covered with grass, and occasionally presenting a few detached hills. He soon afterwards crossed the river Tacazze, and then arrived at the mountains of Samen. Of the difficulties of passing these remarkable heights, it may be allowed that he has given a faithful report; but, in his description of the hills themselves, especially as to their forms, he has made, perhaps, rather unfair demands on the credulity of his reader. It required, indeed, great confidence in that principle, to assert, that some of these hills are like pyramids, pitched on their points, with their bases uppermost! Mr Salt assures us, he did not see a single instance which corresponded with such a description; and most readers, it is presumed, even allowing a good deal to fancy, would incline to deny the existence of such anomalies without the aid of his authority. Mr Bruce, with great perseverance, and much toil, reached the top of Lamalmon mountain, on the north-west part of the high land of Samen, of which he has given an interesting account. It is surmounted by a large plain, from which issue several springs, the sources of the principal rivers in this portion of Abyssinia. On approaching Gondar, the country improved in cultivation. His account of this capital, and of the various events in which his residence in Abyssinia engaged him, will afford much entertainment to the reader.

Salt's Journey.—Mr Salt, in both his journies in this country, set out, as Mr Bruce had done, from Arkeeko, in the direction of Dixan.

Arkeeko is an assemblage of miserable huts, inhabited by a set of rogues and half-civilized savages, who have contrived, whilst losing the rude virtues of their original state, to imbibe the worst vices of people more advanced than themselves. It is scantily supplied with fresh water from six wells, about a mile and a half distant; where it is usual for men, women, and children, to assemble in the evening, for the purpose of collecting and carrying it in skins, as is common throughout eastern countries. Passing these wells, to which the name of Illerbehey is given, Mr Salt reached a rising ground called Shillokeab by Mr Bruce. The road onwards to Weah, which is a small stream or torrent, lay over a rugged ridge of low hills, the basis of which consisted chiefly of granite, rising above a bed of micaceous earth; and the face of the country was nearly covered with the thorny Acacia, whose sun-burnt leaves afforded little repose to the wearied eye. A short distance from Weah, which is conjectured to be about 18 miles from Arkeeko, there is a forest of girá trees; and a little beyond this, the mountains commence, along whose ravines and declivities there is a winding road, which continues as far as Taranta. Some encampments of the Hazorta, a wandering tribe, and a village or two, were passed on the way. In both his journeys, Mr Salt found the thermometer to stand above 80°, near the same situation, in the months of February and July. The hills now met with, are generally described as composed of burnt brown stone, with a few layers of white spar; and, at one point, we are told, a rock was found, which contained so much iron as to affect the compass. Some springs and natural cisterns were occasionally seen. Torrents were frequently encountered; and both Mr Bruce and Mr Salt, it may be remarked, experienced a dreadful storm, nearly at the same place. A few very pleasant spots, called Sadoon, Tubbo, &c., partly described by Mr Bruce, yielded the refreshments of water, some fruits, game, and, above all, the enjoyment of beautiful scenery. The Hazorta, Welleihah, Bedowee, and many other tribes, had taken up their abode at various points of this course; some of whom were, perhaps, nearly as much to be dreaded as any of the wild beasts which occasionally roared around them. It was found practicable, however, to get through both, without any very material inconvenience; and, at last, the pass of Taranta was reached, which Mr Bruce had described in so terrifying a manner. Immense difficulties, of course, were anticipated by Mr Salt in his first visit to this noted region; but his experiencing how easily he could overcome them in three hour's time, including several delays, so far moderated his apprehensions on his second journey, that he found leisure to amuse himself with the many beauties and rarities which presented themselves.

The view that bursts upon the traveller when he attains the height of Taranta, is said to be one of the most magnificent that imagination can delineate; "extending over the abrupt mountains of Tigré, to the pinnacled and remote heights of Adowa, and singularly diversified with patches of vegetation, extensive forests of Kolqual and numberless intersecting vallies." The thermometer, on the summit, varied from 59° to 66° in the month of July.

A remarkable change of climate was experienced on reaching the wild and rocky district that stretches from the foot of the mountain towards Dixan. The sun was hot and scorching; vegetation had a parched appearance; the brooks were dry; and the cattle had been driven off in search of pasture. Many of the rocky mountains, in the country round Dixan, are planted with villages constructed much in the same manner, only with flat-roofed houses, having neither windows nor chimneys. The place of the latter is badly supplied by two pots of earthen ware, rising out of the roof. A chapel, the only public building in Dixan, is held in great veneration by the priests and people in general, who have a great fondness for crosses, and a strong propensity to kiss whatever they hold sacred. But their religion, unfortunately, seemed to have no efficacy in reclaiming them from the vices of idleness, ignorance, and dirt—a defect, too serious in its consequences to be compensated by the foolish habit of uttering some jargon, profanely denominated prayers, on the most trifling occasions.

Marriages, &c.—Here we may mention several peculiarities, noticed as general with this people. Circumcision is practised. Boys marry at fourteen years of age, and girls sometimes so early as ten. The laborious occupations devolve, as is not unusual in half-civilized countries, on the female sex. Polygamy is allowed; but there is always one wife to whom the law allows a superiority in point of consequence, however the affections of the husband be elsewhere disposed of. Marriage itself is generally held to be a merely civil institution, the priests rarely officiating at the ceremony. There is indeed a holier kind, at which they assist, when the parties take the communion, and this is reckoned to be indissoluble—a very sufficient reason why, in a country where licentiousness is on the increase, the common mode of coming together, which allows of very easy separation, is now universally preferred. It is curious, that the wife always preserves her own name. She is entitled also, which is a still better institution, to recover the whole of her dower, in the event of the husband's misbehaviour occasioning her to quit his home: but it is lost on her own infidelity being proved—an event, perhaps, not of very easy discovery, as the law requires her to be caught in the act. Another peculiarity, of no small interest, has often been aimed at by the fair sex in other regions; the ladies of rank are accustomed to assume a high degree of superiority over their husbands!

South from Dixan lies the plain of Zarai, which, Mr Salt says, reminded him of the vale of Evesham in Worcestershire. It was highly cultivated, and disposed in ridges, for the convenience of irrigating the land; a practice not unusual in this country. Still further south, beyond the village of Ascariah, and a pretty steep declivity, there is another fine plain, called Serawé, which forms a part of the western boundary of the mountains of Taranta, which have a remarkably wild appearance from this position. Onwards is the picturesque village of Abha; and there are several other villages scattered throughout this part of the country. The church at Abha is partly excavated out of a rock, rather difficult of access, and apparently not so often visited as that at Dixan. A weekly market, held in the immediate vicinity, attracted much more notice; man's physical wants, here, as elsewhere, commonly obtaining most of his regard. Not less than three hundred persons had assembled to barter their various goods, such as horses, cattle, skins, butter, iron wrought and unwrought, &c. &c. much in the same manner, and no doubt with equal avidity, as in any English village; and nearly as many more were met with on the road, in straggling parties, conveying their merchandize; a pretty good test of the population and prosperity of the place.

In his first journey from Abha to Antalow and Chelicut, Mr Salt went by the east of the Devra Damo, and Haramat mountains; and in his second, he took the western side of this ridge. The former route lay through a number of villages, most of which are small and inconsiderable. The country, in this direction, exhibited very various appearances; as insulated rocks, difficult mountain passes, hills of remarkable forms, extensive flats, cultivated vallies, rich pasturage, many plants of great beauty, vast herds of cattle, and flocks of sheep. On the whole, making allowance for peculiarities in manner and habit, a good deal of hospitality was experienced; and, in general, maize, the intoxicating beverage commonly drunk in Abyssinia, and which is prepared from honey, fermented with barley, and strengthened by a bitter root called taddo, was supplied in very liberal doses. This is the liquor which Mr Bruce calls hydromel. The other course conducted Mr Salt to Logo, a large town near the river Seremai; the village of Legote, which bore a resemblance to Dixan; a remarkable pass, called Kella, a word signifying, in the Abyssinian and Arabic languages, "a castle," and given to it on account of the shape of the rocks in its neighbourhood; a very rugged mountainous dictrict, where the path was so steep as to require the travellers to dismount from their mules; a very extensive plain, stretching from the hills of Agame and Haramat, in a westerly direction towards the river Tacazze; another pass, leading to the district of Giralta; and the towns of Mugga, Gibba, and Moculla, situate in the rich and fertile plain of Gambela. Of the information collected in these two tracks may be mentioned a few particulars, illustrative of Abyssinian manners, &c. The bad contrivance of the houses with respect to chimneys, exposes the people so much to smoke, that even many of the children were nearly blinded by it, and almost every woman advanced in years had lost either one or both eyes. On the death of near friends, the Abyssinians go into deep mourning, both men and women clothing themselves literally in sackcloth and ashes. They shew also their affection for the dead, by tearing the skin off their temples; a practice something similar to what prevailed amongst certain ancient people, and is now found in some of the South-Sea islands, viz. cutting and maiming the body as a token of grief. Lent is observed by the higher classes with very particular attention.

The unfortunate dissensions which existed during both his visits to this country, prevented Mr Salt from going to Gondar. But the friendly disposition of the Ras Wallad Sélassé enabled him to traverse Tigré in any direction he chose, and contributed materially to his opportunities of acquiring information on every subject he deemed worthy of his regard.

Eating Raw Flesh.—One of the most extraordinary relations contained in Mr Bruce's account of this country, and which, perhaps, more than any thing else exposed him to censure, was that of a practice which he attributed to the people, of cutting portions of flesh from the bodies of living cattle, and serving them up quite warm, and without preparation, to the table. The barbarity of this action was thought so extreme, that perhaps any man's veracity would have been questioned who should have asserted its reality. There required nothing more, then, in addition to certain other very debateable points, to bring on him the charge of falsehood. Mr Salt seems to have gone into this common accusation, during his first journey. His observations did not prove the alleged enormity, though they were ample enough to ascertain a very considerable approach to it, in the common practice of eating slices of flesh, called *brinde*, taken hot and quivering from the slaughtered animal. His own account of a feast of this sort, therefore, is abundantly horrible and disgusting. To be sure, the life, at least the sentient principle, was not present, to give the exact amount of Bruce's previous statement; but a little candour might have suggested the possibility of complete coincidence, in certain situations, different from those in which he himself happened to be placed. Accordingly, in the narrative of his second journey, he is actually induced to make mention of scenes of barbarity, which, to use his own words, "appear strongly to corroborate the account given by Mr Bruce!" The statement is made by Mr Pearce, one of his establishment, and is too curious to be omitted. "Mr Pearce went out with a party of Lasta soldiers, on one of their marauding expeditions; and in the course of the day they got possession of several head of cattle, with which, towards evening, they made the best of their way back to the camp. They had then fasted for many hours, and still a considerable distance remained for them to travel. Under these circumstances, a soldier attached to the party proposed "cutting out the shulada" from one of the cows they were driving before them, to satisfy the cravings of their hunger. This term Mr Pearce did not at first understand; but he was not long left in doubt upon the subject; for the others having assented, they laid hold of the animal by the horns, threw it down, and proceeded, without further ceremony, to the operation. This consisted in cutting out two pieces of flesh from the buttock, near the tail, which together, Mr Pearce supposed, might weigh about a pound; the piece so cut out being called "shulada," and composing, as far as I could ascertain, part of the two "glutei maximi," or larger muscles of the thigh. As soon as they had taken these away, they sewed up the wounds, plastered them over with cow-dung, and drove the animal forwards, while they divided among the party the still reeking steaks. The animal, after this barbarous operation, walked somewhat lame, but nevertheless managed to reach the camp without any apparent injury; and immediately after their arrival it was killed by the Worari, and consumed for their supper!" Mr Salt immediately afterwards remarks, that the fact of this practice being occasionally adopted was certainly placed beyond all doubt, by the testimony of many persons, who declared that they had likewise witnessed it, particularly among the Lasta troops.

Feasts, Amusements, &c.—*Brinde*, though a favourite dish, is by no means the only one that constitutes an Abyssinian entertainment. There is considerable variety of fare in the houses of persons of rank. Cowheel, grilled mutton, curried fowl, fish of different kinds, with an abundance of fruit, yield sufficient enticements to the indulgence of appetite. The people, especially those of rank, when entertaining, shew a good example in doing justice to the feast, eating and drinking enormously; and it seems to be considered as essential to kindness, that they should press their guests to do the same. Solicitation to this effect, however, is not here as in some other countries the only means adopted to overcome the reluctance, or satiated feelings of their friends. On the contrary, the host would be thought very deficient in politeness and hospitality, if he did not actually put his victuals into their mouths, much in the same manner, we learn from Mr Salt, as boys feed young magpies. A very modest man, therefore, in such liberal hands, would stand no small chance of being crammed to death. Marriages, births, and all other convenient occurrences are taken advantage of, to administer festivity to this active and lively people. Their rejoicing is pretty much alike on all such occasions, and is always accompanied by most circumspect regard to the substantials of life. Their mirth, however, which almost invariably degenerates, or improves, as they no doubt think it, into intoxication, is productive, at least amongst the higher ranks, of very few quarrels; and Mr Salt says, he never knew an instance of any one drawing his knife on such an occasion. In their private parties, a great degree of freedom is enjoyed, and the sexes are by no means restrained in their very natural desire to associate. Their conversation does not seem to be the most refined, or altogether very delicate, even in presence of the ladies, who do not scruple to *hear* things with a good grace, and some apparent satisfaction, which elsewhere would be so totally unintelligible to them, as not to produce a single emotion. The young women, however, are said to be well educated; and no doubt the early marriages of the country are very beneficial, as the husbands in general are fully disposed to watch the preservation of their morals. Children are treated with severity, and those who are illegitimate do not inherit the father's property, but are considered nearly in the light of servants. Land descends from father to son, and if there is no son, to the brother. All the children, however, and the relations, have a claim to a maintenance. The poor and the distressed are, on the whole, charitably assisted, and slaves are well treated. Pilfering and dishonesty are far from being rare; and an eagerness for presents is very universal. The people are fond of amusement. Chess is one of their favourites. The indulgence in comic humour is not unusual among them. They have a sort of rude poetry, in which they delight. Musical instruments of a simple kind are pretty common; and some of their pic-

Abyssinia.

tures are not destitute of ingenuity. Few of their manufactures are important;—those of coarse carpets in Samen and at Gondar, from the wool and hair of sheep and goats,—of knives at Adowa,—and spears and razors at Antalow, may be reckoned the chief. The implements of husbandry in use, are very rude; the plough, for example, is shaped out of the root and branch of a tree, to which, sometimes, a ploughshare of iron is added. It is drawn by two oxen, and guided by men only; but, in all the other departments of husbandry, the women have the larger share of labour. Their greatest toil, perhaps, is that of clearing away weeds, which the luxuriance of the soil frequently renews. Reaping is exclusively committed to females.

In his visit to the antiquities of Axum, Mr Salt had full opportunity to correct several errors into which Mr Bruce had fallen, and also to ascertain some points of interest in the history of Abyssinia. The particulars are too numerous to be noticed here. He was less fortunate, in being prevented, as we have mentioned, from going to Gondar. Any account, therefore, we can give of that capital, must be collected from the previous information of Mr Bruce, and such reports as his repeated inquiries procured him. This, however, is perhaps little to be lamented, as, even admitting the full effect of the opinion which the natives entertained of it, there is not much reason for solicitude as to either the minuteness or the grandeur of the description. The town has neither walls nor fortification. The palace is the principal building. But there are many churches, for the splendour of which, the Portuguese, who formerly had great influence here, must be allowed to claim merit. Gondar is situated on a hill of considerable height, and occupies a large space, as the houses in general are only one story high. It is said to contain about ten thousand families.

Government.—Of the government of Abyssinia, it is extremely difficult, for reasons already mentioned, to give any satisfactory account. In former days it was undoubtedly monarchical, and of the most absolute kind, the will of the sovereign being supreme, and his power irresistible, at least by any thing established in behalf of popular feeling and interest. The throne was hereditary in one family; but the individual who filled it was commonly elected by the ruling minister, who frequently nominated an infant for the successor. The consequences, as might easily be foreseen, were almost perpetual disputes and animosities, amongst the persons of the blood-royal. To prevent mischief from this cause, it was usual to confine the members of the royal family in the mountains of Week-ne or Way-gne, and in other fastnesses, in a state of complete seclusion from the business of the state, and, indeed, the common concerns of life,—a peculiarity in Abyssinian history, of which Dr Johnson has availed himself, in his beautiful fiction of Rasselas. This custom has been abolished for several years, and the princes now usually live in a kind of dependent condition on the chiefs of the different provinces, who may be said to have shared among them the power and consequence of royalty. This being the case, and Abyssinia having, in fact, dwindled into a sort of rival and uncombined aristocracy, it is less necessary to occupy room in any account of the national revenue, the kind and number of state officers, or other peculiarities of constitution and government, which form so essential a part of the history of most nations.

Money, &c.—In place of coin, or even of massive gold and silver, the Abyssinians employ pieces of salt, obtained originally from the salt plain, and cut into different sized pieces, for the medium of trade. Cotton cloths sometimes answer the same purpose. Recently, it seems, foreign coins have been introduced, which, in more favourable circumstances of the country than have long existed, would, probably, from its much greater convenience, give rise to a national currency of the precious metals. Perhaps a small kind of glass beads, which are commonly used in the minor payments, is to be considered as the more important approximation to such an advantage, as indicating the universal acquaintance with the operation of what may be called a representative system of exchange. The Abyssinians have measures of capacity and weight, which, in their various subdivisions and modes of adjustment, indicate a suitable degree of attention to the necessary trading occupations.

History.—The early history of Abyssinia is involved in the greatest obscurity, and seems to present difficulties which it is impossible to solve. To ascertain even the origin of the people who have so long inhabited this country, would lead to discussions of no ordinary compass or perplexity. Till lately, indeed, the opinion of Ludolf, that they were derived from the Arabians, was so commonly received, that it might be assumed, unsupported as it was, and liable to serious objections, without apprehending the smallest opposition, or any unfavourable imputation. It is not the least merit of Mr Salt, that he disputes the evidence on which this opinion was founded,—for it is praise-worthy to arrest the despotism of fictitious authority; but, in addition, he has assigned reasons of at least a very plausible appearance, for the supposition that Egypt, and not Arabia, is the country whence the Abyssinians proceeded. The only strong objection that seems likely to prevent the general adoption of this supposition is, what the late very learned editor of Bruce's Travels, Mr Murray, remarked, as to the similarity between the Geez and Arabian languages. But this is readily enough explained by Mr Salt, on the principle which that gentleman himself maintained, viz. that the Hebrew, being the most ancient language in existence, is the common stock from which they have been derived. This reply, it is obvious, is merely an *argumentum ad hominem*, and may not obtain the assent of those who deny the major proposition. Besides, as it might easily be shewn, the consequences of this proposition, even admitting its truth, are of so general an application, that we must discard it entirely from the investigation, unless we mean merely to prove, what is not disputed in this case, that the Abyssinians and the Arabians are descended from Noah. It would have been better, perhaps, if Mr Salt had chosen a more special ground for the defence of his opinion, and had been at some pains to inquire, or at least to state, what probable events had preserved the resemblance of language, whilst the institutions, modes of building, dress, written characters, and other peculiarities of one of these people differed so materially, as he affirms they did, from those of the other. Now, in this respect, we think he might have been most materially aided by the labours of the industrious Bryant, who perhaps has done more towards the elucidation of this point of history, though merely incidental to the peculiar objects of his research, than any previous or subsequent author. We refer the reader to his Analysis of Ancient Mythology, especially that part of it which treats of Cushan, or Ethiopia, as it has been commonly called. He will there discover a reason for much of the obscurity and contradiction, to be found in those writers who have treated of the origin and early history of the people to whom the term of Ethiopians has been applied, in a circumstance not attended to by them. We mean, that the term Ethiopia, which is not, as is usually and absurdly imagined, a word of Greek original, alluding to the dark or burnt-like countenances of the people, but a term of sacred import, in fact a title of the chief Deity, was not confined to that region in Africa which, in modern times, has been so denominated. On the contrary, there were several countries which bore the name, in consequence, no doubt, of their inhabitants being fellow-worshippers of the same God, known to them by that appellation. We shall find, in fact, an Ethiopia in most places where the descendants of Cush or Chus, so noted for their wanderings, had taken up their abode. Thus the sacred Scriptures speak of three countries, to which the name has been given; viz. one in Arabia, on the borders of the desert, near the land of Midian and the Red Sea; the second, that which is to the south of Egypt, on the western side of this gulf; and a third, which comprehended the regions of Persia, Chusistan, and Susiana, and which was watered by the eastern branches of the river Tigris. But these were not the only countries so called; for Mr Bryant has adduced evidence, that, not only a region still farther to the east than the last mentioned, but also the Colchis of the Greeks, part of Syria and Phœnicia, Arabia Felix, Egypt itself, nay, even a district in Spain, near the straits of Gades, or Gibraltar, as it is now called, besides several other places, had obtained this appellation, and that unquestionably, for the very same reason. The original settlement of the family seems to have been in the region of Babylonia and Chaldea, from which one large branch, preserving for a long time the name of Cuseans, in honour of their progenitor, in addition to that derived from their religion, extended southwards to the country afterwards known by the name of Arabia. Another branch, for we shall not trouble ourselves with the smaller divisions, retaining also both names, but not for so long a period the latter one, and acquiring a new title from their principal occupation, viz. Auritæ, or shepherds, went into Egypt, and for a time settled in a place long afterwards denominated Goshen,—a word, most probably, derived, by a mere difference of dialect, from the term Cushan, which again is evidently very strictly referable to the boasted origin of the people from Cush, the grandson of Noah. Both Arabians and Abyssinians, it may be remarked, glory in having descended from Ham, the father of Cush. If what we have now said be correct, their mutual claim is a just one, and we have no difficulty in understanding how, in one of the most permanent characteristics of a people, that of language, they should still offer some traces of resemblance and of identity of progenitorship. The reasons why in many other respects they differ, it will be easy to assign, in few words. The Arabians were the original and the only inhabitants of the country whither they went on leaving the primitive settlement, and were, therefore, no way exposed to receive modifications of their own peculiarities of language, religion, or institutions. Whereas, the other branch was immediately brought into contact with the descendants of Mizraim, whom it found in possession of Egypt, and whose deep-rooted fastidiousness, and disdain of novelty, would, in all probability, require a very decided sacrifice of the distinguishing features of all strangers attempting an intercourse with them. Even the subsequent conquest, and long dominion of Egypt, which these people effected, could not be accomplished without very important changes in their own economy; and these, it is quite easy to imagine, must have arrived at the greatest height, when they were at last effectually opposed by the people of Upper Egypt, and obliged to abandon the country, after a cruel tyranny of nearly three hundred years duration. We conceive, then, that the people who inhabited what is properly denominated Ethiopia, are the descendants of some of those Cuseans who successfully invaded Egypt, but who were at last driven out in various directions a considerable time before the arrival of the sons of Jacob in that country.

The conjectures now stated, which it would no doubt require much room and considerable research to substantiate, will afford an easy method of reconciling some otherwise inexplicable discrepancies in the history of Abyssinia, besides accounting for several remarkable instances of similarity between them and two other nations, those of Egypt and Arabia, who were nevertheless very widely distinct from each other. But we must leave the subject for the curious reader's investigation.

The city of Axum, already spoken of, was the first which these emigrants built; and this the Abyssinians *assert*, on the authority of their traditions, to have taken place in the time of Abraham. It was from this city, that the Romans, in after times, gave the name of Axomites to the Abyssinians. Many ages elapsed from this commencement of their power, till we are furnished with any satisfactory information respecting their progress as a nation. We learn, certainly enough, that they were joined by stragglers from Egypt and other countries,—a circumstance which probably gave rise to the term Habesh, signifying 'convena,' an assemblage of different people; and that they were noted for their commerce, and its attendants, wealth and civilization. Among the doubtful, if not the impossible, events concerning them, it is sufficient to specify the conquest of their country by Moses the Jewish legislator; the visit of one of their sovereigns, viz. the person called in Scripture the queen of Sheba, to Solomon at Jerusalem, and her pregnancy by that monarch; the consequent introduction of the Jewish religion into Abyssinia; the invasion of the country by Shishak, king of Egypt; and the conquest of it by Cyrus the Great. As to these and several other incidents, which it is unnecessary to mention, we shall merely remind the reader of what we have alreay said respecting the application of the word Ethiopia, as affording a ready solution of seeming paradoxes and real absurdities.

We have evidence, though few particulars, of the conquest of Abyssinia by Ptolemy Evergetes, one of the successors of Alexander. It is still more clearly established, that the Romans, in the time of Augustus, carried their victorious armies into some of its provinces, and that Candace, the queen of Meroe, one of its chief cities, and probably the sovereign of the country, contrived to obtain very honourable terms from that prince, who, in all probability, thought its complete subjugation to be unworthy of his regard. Queens of the same name, Candace, are said to have reigned in Ethiopia for several generations. One of them is mentioned in the book of the Acts of the Apostles: Yet, it is singular, that this name is not found in any of the lists of kings of Abyssinia furnished by Mr Salt from the ancient chronicles of this people. Perhaps there is reason to think, that a very different nation from that of which we are now treating is alluded to in both these cases. In short, till about a century or two after the Christian era, the history of Abyssinia is nearly altogether unknown to us. Then, however, it begins to assume consistency. This is owing to its commercial connection with Egypt, and the introduction of the Greek language. By the former circumstance, both the people of this country, and the Arabians of the opposite coast, who had long carried on a very extensive trade with India and Africa, were brought into notice in the Roman empire; and by the latter, a medium of communication was established, which served to produce a more general attention to their transactions. But the declining affairs of the Roman empire, the great distance of this country from the seat of power, and the still vague accounts of it which prevailed, were obstacles to the production of the natural benefits to be expected from this advantage.

Abyssinia shared, however, in the effects of the conversion of Rome to the Christian faith. Accident, not design, introduced it into the former, in the early part of the fourth century. It soon took root, and pervaded every part of the government. Abyssinia became dependant on the patriarch of Alexandria, to whose spiritual labours it has almost always since proved an addition of solicitude and perplexity. Its ecclesiastical affairs, indeed, form the most interesting portion of its modern history. The reason is easily stated. In fact, scarcely any public transaction in which the Abyssinians were engaged for many centuries, had not a reference to what they, perhaps, more than almost any other people, might denominate a contention, not always very successful, for "the faith once delivered to them." Abyssinia acquired consequence with its religion; and an alliance which Justinian made with it in the sixth century, cannot be said to have demeaned that Emperor. Considerable proficiency in arts and sciences, the entire possession of the Red sea, the conquest of Arabia, may be allowed, in addition to their professing at least a kindred doctrine, to redeem the Abyssinians of this period from the imputations of savageness and insignificance. Had these advantages been permanent, or had the friendship of Rome been equalled by its ability to assist in the common cause, there is every reason to believe, that the arms of Mahomet would never have contributed to the agency of his imposture; and thus the world would have been deprived of one of the most humiliating proofs of the weakness and caprice of mankind, when assailed by a fanaticism which has both sensuality and the sword to enforce it. The exception in favour of this people, abandoned by their friends, declining in their commerce, disheartened by their calamities, as they were, is one of the most singular spectacles in history. The most expectant admirer of their resolution, however, must have failed in his hopes, had not the fortunate discovery of the passage to India, by the Cape of Good Hope, brought seasonable aid to their exertions. The immediate consequence of the arrival of the Portuguese in Abyssinia, which followed this discovery, about the middle of the sixteenth century, was a more effectual opposition to the Mahommedan power than it had hitherto experienced in this quarter. The victories of De Gama, the leader of these enterprising and warlike Europeans, secured, for a time, the peace of Abyssinia, and revived in it the languishing spirit of improvement and civilization.

The connection between Abyssinia and Portugal, it ought to be remarked, was of an earlier date than the important discovery of the practicability of doubling the southern cape of Africa; and in a great degree, indeed, it may be said to have contributed to the accomplishment of that event. There cannot be a doubt, at least, that the accounts which the priests of the former country gave, at Jerusalem and Alexandria, of the eastern regions with which their countrymen continued to trade, were instrumental in exciting the attention of the commercial states of Europe to the probability of renewing an intercourse with them, which in former times, and by another route, had been found profitable. King John II. following the example of his grand uncle, Prince Henry, the enlightened instigator and patron of those plans of discovery in which the Portuguese were at this time so eagerly occupied, was the first to take advantage of these accounts, and of the medium through which they were reported. Peter de Covilham, one of the persons sent out by him towards the east, in search of more particular information, having gone from Alexandria to Cairo, Suez, and Aden, sailed thence across the Indian ocean, and reached Calicut on the coast of Malabar. On his return to Cairo he was met by two Jews, whom the king, with his usual foresight, had ordered out with fresh instructions. One of these carried home the account of the observations he had made during his interesting expedition; and, with the other, Covilham set out from the island of Ormus, in the Persian gulf. Thence he returned to Aden, and ultimately arrived in Abyssinia, where he was well received by the Emperor Alexander, and elevated to very important state offices. To his judicious communications during the long residence he made in this country, which commenced about 1490, we must ascribe the encouragement the Portuguese received to prosecute their efforts towards discovery; whilst, on the other hand, his advice, in some critical emergencies, induced the Abyssinians to have recourse to an alliance with that power, as alone capable of retrieving their affairs from the ruin that threatened them. An embassy to the Court of Lisbon, under Matthew, an Armenian, was graciously received. A return was made in 1520; and thus was effected a direct intercourse between the two countries, which promised the most important results to both.

A just opinion of their superiority, enhanced by gratitude for considerable benefits, secured the attachment of the Abyssinians to their European allies. Probably this had been consolidated by a scrupulous regard being shewn, on the other part, to their ancient prejudices, which would certainly almost have given way to the lenient influence of moderation and a respected example. It was undoubtedly impolitic and unreasonable afterwards to condemn and anathematize the minor differences of a creed, which, when first discovered, had been in general considered a cause of the greatest exultation. Such, however, was the conduct of the Portuguese. Their admiration of the Abyssinian faith, which operated so essentially to the interests of this country, when first visited, was speedily converted, by an unrelenting bigotry, into a source of the most absurd and oppressive exactions. These could not be made palatable, even by the insidious arts, or the useful favours, with which the Jesuits, who were appointed to the labour, sought to add new lustre to the spiritual triumphs of Rome. When pressed by difficulties, or threatened by calamity, the emperors would promise obedience as an essential condition of the assistance required. But performance was a tardy follower on the relief obtained. In a few instances, indeed, the vows which distress extorted were kept when it was removed; and, on one occasion, especially, a Catholic patriarch had the satisfaction to receive the homage of an Abyssinian monarch, and his abjuration of the Alexandrian faith.

For similar and still greater success, the really meritorious Paes was indebted, not less to the extreme prudence and consideration which he had exhibited since his arrival in this country, about 1600, than to the immense superiority which the Jesuits, whom he employed in a controversy, displayed over their feeble opponents, the native priests. The people, however, were far less docile, and seemed in general to be insensible alike to the painful instructions of experience and the policy or devotion of their monarchs. Tumults, rebellions, and bloodshed, testified their abhorrence of the novelties attempted to be imposed on them, and their full and invincible determination to believe and to worship as their fathers had done. Extermination seemed the only measure fitted to accomplish the views of the frantic and obstinate Mendez, who succeeded Paes in the patriarchate; and to this, apparently, neither the disposition of his heart, nor the suggestions of his judgment, presented any obstacle. The army, however, paused in the work of destruction; and the infatuated emperor, Socinios, had the misery to survive the slaughter of his subjects and the universal resistance of his impious decrees. An act of toleration, the re-establishment of the ancient religion, and the resignation of the crown to his son, which were the last measures of his reign, were the surest tests of the madness by which it had been actuated, and of the extreme fallibility of Popes and Jesuits in directing the affairs of his kingdom.

Facilidas, his successor, pursued a different line of conduct, though, in one respect, the resemblance was obvious. The principle of intolerance, in fact, was the same in both, but the objects on which it was exercised had varied. Mendez and his brethren were ordered to leave the kingdom, but delaying their departure, were either executed or sold as slaves; and the Roman Catholics, throughout Abyssinia, were commanded, on pain of death, to renounce their religion. This does not seem, on the whole, to have proved a very difficult task, and few persons availed themselves of the opportunity of martyrdom which it afforded. Some feeble attempts were occasionally made by other missionaries, during this reign, to introduce or revive the faith of the Romish church; but they were uniformly unsuccessful. Thus, then, may be said to have ended a contest for religion that had lasted upwards of a century; and, to use, with some modification, the words of the eloquent Gibbon, "the gates of this solitary realm seemed for ever shut against the arts, the sciences, and the fanaticism of Europe."

The disorder brought on by these impolitic efforts to subvert the popular faith, was not confined to the period in which they were made. The whole machine of government became deranged; irregularity and confusion marked all its operations; fear and distrust pervaded all ranks of the people; and usurpers and aliens seized upon the throne. Factions and revolutions within, and the attacks of barbarous neighbours, fill up the remaining history of this unfortunate kingdom, and seem naturally enough to have proceeded from this disorganizing cause, though its influence was long overlooked in the abundance of newer dissentions. The arrival of missionaries from the same church, in 1751, revived its memory. Impelled by the same zeal, they commenced their labours in the same manner, operating on the hopes and fears of the emperor and his court. But all their exertions were fruitless, and ended in equal disappointment, from the reluctance and aversion of the people.

Of the complete failure of this perhaps final effort of the "Propaganda," notwithstanding its early promise on royalty at least, the reader will find a translation of an interesting document in Mr Salt's appendix. Mr Bruce, who has drawn up an able summary of Abyssinian history, does not appear to have been acquainted with this production, though an observation in his original memoranda alludes to an event corroborative of its contents. To the works of these enterprising travellers, we must necessarily refer for information respecting the minuter particulars of Abyssinian history.

Before concluding, however, we shall make a few remarks on the present posture of affairs in this distracted country. The chief of Amhara, when Mr Salt left Abyssinia, was Guxo, who originally had the command over Begemder and the eastern provinces only, but who had greatly enlarged his dominions by the conquest of Damot and Gojam. This rendered his power absolute on the western side of the Tacazze, and his recent connexions with the southern Galla have served to confirm it. He is said to be able to bring 20,000 cavalry into the field; but this force, which constitutes the main part of his army, is inadequate to offensive war against Tigré, although quite sufficient for the defence of the conquests he has already made. It is probable, however, that no long time may elapse, ere the Galla, in union with him, shall have acquired strength enough, not only to overrun the provinces of Shoa and Efat, already detached from Tigré, but also, by the conquest of that state itself, to complete the subjugation of the kingdom. The reduced and daily weakening condition of the government rendered such an event extremely probable previously to Mr Salt's visit; and it is obvious from his account, that, unless some friendly aid be given, no effectual struggle can much longer be made to restore the ancient splendour of Abyssinia, or to prevent it from passing into the list of extinct empires. How far this is to be lamented we shall not conjecture; but that almost any assistance, however small, on the part of the British government, might prove available against its occurrence, seems fairly enough to be inferred from the effect already produced by that gentleman's visits, in augmenting the consequence of Tigré, and giving it a preponderance over the other states. The possession of two small field-pieces, which he was directed to take as a present to the Ras, and which he was fortunate to convey in safety, notwithstanding many difficulties, will enable that chief to retard the threatening fate of his country. But he would require still greater help to secure its independence, or to establish its dignity. The principal obstacle to such assistance is, the want of communication with the coast of the Red Sea, through which alone any intercourse with Abyssinia can be conveniently carried on. Besides the intervention of the Dumhoeta, and other tribes, Massowah and Suakem, two considerable ports, offering the easiest access to it, are at present possessed by the deputies of the rulers of Jidda, whose exactions and unfriendly conduct prevent merchants from carrying on any steady or profitable commerce with this region. It is not to be doubted, however, that a respectable force under the British flag, already so dreaded, would easily accomplish any purpose which it might be necessary to put into execution. Mr Salt argues for this measure as essential to the safety of our Indian possessions, which he thinks threatened, though surely with very remote danger, by the increase of power on the part of these hostile rulers. They are said already to command both sides of the gulf, by several armed ships of four and five hundred tons burden, besides having a fleet of *dows*, carrying each from six to eight guns, and manned by the desperate ruffians composing the population of Jidda. Without going the length of Mr Salt's apprehensions, we concur in opinion as to the advantages of at least protecting some port on the Abyssinian coast. The important benefits resulting to the Abyssinians from this measure, would undoubtedly bequeath on them the debt of gratitude; still, however, a new and probably large demand for English and Indian goods, the acquisition of a cordial ally to watch over our interests in a quarter where danger has been suspected, not to speak of the satisfaction arising from generosity towards an ancient Christian power, reduced to implore our kind offices,—might prove amply remunerative of any expence or trouble which we bestowed on the enterprise. It is no doubt gratifying to think, that the arduous contest in which we have so long been occupied, has not altogether prevented the attention of our government to this very interesting point. The mission of Mr Salt, with a present from our Regent, may be allowed to form the basis of some hope in behalf of Abyssinia. And now, (August 1815,) that our efforts have ended so gloriously for our arms, it is reasonable surely to think, that still greater regard will be shewn to the superstructure. If so, the suggestions of Mr Salt, we have no doubt, will be effectually adopted. The most complete success may be anticipated; and we should have another, and perhaps not the least pleasing instance, in this most extraordinary age, of the power and liberality of Britain in restoring the ancient order of kings! Far be it from us to applaud such efforts, if our national morality were to be violated in their display, or if even hostile powers should have the slightest grounds to charge our interference with selfishness or dishonesty. But the apprehension seems unnecessary. We, at least, are convinced, that the conduct, which, on political grounds, it would be prudential in our government to adopt in this case, may be defended on principles strictly recognizing the rights and the real interests of every other power that might happen to be concerned in its success. On the whole, perhaps, the reader will agree with us, that the Abyssinians want neither inclination nor ability to become a powerful people, and that the untoward political circumstances with which they have long contended, rather than any deficiency of character or unkindness of nature, prevent them from sharing in the benefits which free intercourse, and the cultivation of mutual interests confer on more fortunate nations. Separated as she now is from the sea, shaken by internal convulsions, and beset on all sides by malignant rivals, Abyssinia, nevertheless, is able, by the warlike spirit of her people, the intelligence of her chiefs, and the remains of an emulation, which was formerly indeed more successful, to command respect and forbearance from her hostile neighbours. She is still of consequence, therefore, in the scale of nations, and could scarcely disparage any power that might incline to make her greater. The experiment would at least be meritorious, and would hazard little. Who knows, but that, in after times, its results may be registered amongst the brightest examples of British beneficence and policy?

ACACIA, is the trivial name of several plants, the flowers of one of which are employed by the Chinese in painting on paper, and in communicating a beautiful and durable yellow to cloth. The same word denotes the extract, or inspissated juice, obtained from the *Mimosa Nilotica*; and a similar preparation from unripe sloes, which is sometimes employed as a substitute, is called *German acacia*.

ACACIA, a name which has been given to the figure of a roll, or bag, in the hands of consuls and emperors, which is represented on ancient medals. It is supposed by some to be a handkerchief rolled up, with which signals were made at the public games; or, according to others, it is a purple bag filled with earth, which was carried by some of the consuls and emperors, as an emblem or memorial of their mortality.

ACACIUS, ST. bishop of Amida, who flourished about the year 420, and was greatly distinguished by his charity and humanity; a remarkable instance of which is recorded, in the redemption of 7000 Persian slaves, who were perishing with hunger, at the expence of the church plate, which was sold for this beneficent purpose. When they returned in safety to their own country, Veranius, their king, was so impressed with this noble act of the humane and generous bishop, that he anxiously desired to see him. An interview too place, and produced the happy effect of establishing a peace between the Persian prince and Theodosius I.

ACADEMICS, the name by which the disciples of an ancient school of philosophy are distinguished. Socrates was the founder of this philosophy; and Plato first established a school for teaching it, in a garden, or grove, near Athens, which had been bequeathed to the citizens by a person of the name of Academus, for the purpose of gymnastic exercises; and hence the school was called the *Academy*, and its disciples *Academics*. Three periods, characterized by the diversity of doctrine which prevailed, mark the progressive history of this celebrated school, and have received the distinctive appellations of the *Old*, or *Ancient*, the *Middle*, and the *New* Academy.

Plato, and his immediate successors, ascribed the difficulties which oppose the discovery of truth, not to the nature of things, but to the imperfection of the human faculties, and therefore recommended modesty and diffidence, caution and circumspection, to those who would successfully pursue it; and while this method of acquiring knowledge was followed, the school was denominated the Old or Ancient Academy. But new teachers arose; and, disregarding the sound maxims and cautious mode of procedure inculcated by Plato, introduced subtleties and refinements formerly unknown in his system. At the head of these innovators was Arcesilaus, who assumed it as a principle, that no difference existed between truth and falsehood, or, at least, that it could not be discovered. He rejected the testimony of the senses, and the authority of reason. Those who adopted this sceptical philosophy are known by the name of the *Middle Academy*. When Carneades, a native of Africa, was placed at the head of the Platonic school, he abandoned the more absurd and obnoxious opinions of Arcesilaus, and introduced various modifications into his doctrine. He and his followers, one of whom, Philo of Larissa, is celebrated by Cicero for his learning, eloquence, and attractive manners, constituted the *New Academy*. Antiochus was the last teacher of this school during its establishment at Athens; and after his resignation, in the 175th Olympiad, the groves of Academus were disturbed by the horrors of war, the professors were dispersed, and the school itself was removed to Rome.

ACADEMY, in modern times, is used to denote a society of learned men established for the improvement of arts and sciences; and it is also applied to public and private seminaries for the instruction of youth. For an account of Academies of both descriptions, as well as of associations for similar and other purposes, under the name of Society, see INSTITUTION.

ACANTHUS, or BEAR'S BREECH, a genus of plants belonging to the class *Didynamia*. The same word is sometimes used to denote an ornament, resembling the leaves of a species of acanthus, on the capitals of the Corinthian and Composite orders of architecture.

ACAPULCO, a seaport town of Mexico, situated on a bay of the Pacific ocean. It is distinguished by the name of a city, although an inconsiderable place, and containing only about 400 families, chiefly composed of negroes, mulattos, and Chinese. The houses are ill constructed, and generally thatched. The climate is extremely sultry; and the air being frequently loaded with vapours, is insalubrious. On this account the Spanish inhabitants retire from the coast, excepting when business requires their attendance during the arrival of the ships from the islands in the Pacific ocean. The productions of the surrounding country are cotton, maize, fruits, and tobacco. Cattle and sheep are also abundant. The harbour of Acapulco is commodious and extensive, and capable of receiving 500 ships. It is defended by a fort, furnished with a small garrison, and mounted with large cannon. The trade of Acapulco is considerable. A ship sails annually to Manilla, and another returns loaded with the rich productions of the East. The arrival of the Chinese ship, or galleon, presents a new scene. Merchants come from most parts of South America, but chiefly from the provinces of Mexico, and form an extensive encampment in the vicinity of the town, for the conveniency of exchanging cochineal, European toys, and nearly half a million Sterling of silver, for precious stones, Persian carpets, silks, muslins, drugs, spiceries, tea, and gold works. A large proportion of the goods brought by this ship are conveyed to Mexico on the backs of mules and horses; from thence they are carried to Vera Cruz, to be shipped for Europe. Acapulco was taken and plundered in 1580, by Sir Francis Drake. N. Lat. 17° 10', W. Long. 101° 40'.

ACARNANIA, an ancient country on the Ionian sea, separated by the river Achelous from Ætolia, and from Epirus by the gulf of Ambracia. It was a free state, governed by a prætor, with other subordinate magistrates. The inhabitants are represented as an effeminate and dissipated race, but remarkably jealous of their liberty, as well as inflexibly faithful in observing their treaties. As the Acarnanians were strongly attached to Philip, king of Macedon, every attempt was made by the Romans to seduce them from their fidelity. Leucas, their capital, being betrayed by some Italian exiles into the hands of Lucius Flaminius, this event so intimidated the whole country, that the cause of Philip was universally abandoned, and the people remained under the protection of the Romans till the fall of Corinth, when their country formed a constituent part of Achaia. Their year, it is said, consisted only of six months. The modern name of this country is la Carnia.

ACARUS, the Tick, or Mite, a genus of insects belonging to the order *Aptera*. See ENTOMOLOGY.

ACATALECTIC, in *Prosody*, denotes such verses as have all their feet or syllables complete.

ACATHISTUS, a solemn hymn, or vigil, sung in the Greek church, on particular occasions, in honour of the Virgin, for having thrice delivered Constantinople from the invasions of the barbarous northern nations. The term signifies *without sitting*, because the people stood while they celebrated this festival.

ACCAIA, otherwise called *Laurentalia*, were solemn festivals celebrated by the Romans in honour of *Acca Laurentia*, the nurse of Romulus, the founder of their city.

ACCELERATION, signifies the increase of velocity, or the continued accession of velocity in falling bodies, or in bodies passing along an inclined plane, or moving round a fixed centre. See MECHANICS.

ACCELERATION *of the Moon*, is the increase of the moon's mean motion, compared with the diurnal motion of the earth. See ASTRONOMY.

ACCELERATION *of a Planet*, is, when its real diurnal motion exceeds the mean diurnal motion. This inequality arises from the change in the planet's distance from the sun, which is continually subject to variation, the velocity of the planet being accelerated in that part of its orbit which is nearest to the sun. See ASTRONOMY.

ACCELERATION *of the Stars*, is the difference of time between the diurnal revolution of the sun, and the diurnal revolution of the fixed stars, by which they rise and set 3′ 56″ sooner daily. See ASTRONOMY.

ACCENDONES, or ACCIDONES, the name of certain persons among the Romans, whose office it was to excite and animate the gladiators and combatants, in their public exhibitions. The term is derived from a word which signifies to *kindle* or *inflame*, or from another, which signifies to *approach*, or *come near to*.

ACCENSI, in the Roman armies, were the supernumerary soldiers, intended to supply the places of those who were wounded or slain in battle. They were chosen from the fifth class of citizens, and being considered raw troops, were placed in the rear of the army.

ACCENSI, an inferior order of officers, who attended the Roman magistrates, called assemblies of the people, and summoned parties to appear before the judges.

ACCENT, in *Grammar*, is a particular character or mark put over a syllable, by which the management of the voice, in pronouncing it, is to be directed. The Greeks and Romans employed three characters for this purpose, and were the same with those which are used in Britain, viz. the *acute accent* (′), by which an elevation of the voice is marked; the *grave accent* (‵), which denotes a depression of the voice; and the *circumflex accent* (˜), which being composed of the two former, and originally marked thus (ˆ), denotes first an elevation and then a depression of the voice.

ACCENT, in *Music*. Such parts of a bar are said to be accented, as naturally receive the emphasis or expression, whether of the voice or of instruments.

ACCESSION, in *Law*, a mode of obtaining property in things closely connected, or dependent on each other, as in the case of the proprietor of the soil having right to its productions, the proprietor of cattle having right to their offspring, and the proprietor of land on the sea-shore, or on the banks of a river, having right to any additions to that land by the deposition of soil. This is distinguished by the name of *natural accession*. In the case of artificial additions to land, as in building houses, and planting trees, such houses or trees belong to the proprietor of the land, and not to the person who built or planted them. This is called *artificial accession*.

ACCESSION, among *Physicians*, is employed to denote the paroxysm of a disease; while politicians apply it to the succession of a prince to the throne, on the death of his predecessor.

ACCESSORY, or ACCESSARY, in *Common Law*, denotes a person guilty of a felonious offence, not actually or primarily, but by participation, such as by concealing, advising, or commanding. An accessory, before the fact, is one who prevails with another to commit felony, though not present at the perpetration of the deed; or he who receives, assists, or comforts any person guilty of murder or felony, of which he has a clear and distinct knowledge. But all concerned in rioting, mobbing, and similar offences, and in the highest species of crimes, as high treason, are regarded as principals.

ACCESSORY NERVES, in *Anatomy*, two nerves which arise from the spinal marrow of the neck, and are distributed to the muscles of the neck and shoulders. See ANATOMY.

ACCIDENT, in general, denotes any casual event. Among *logicians*, it is used for whatever is not essential to a thing, as a man's money or clothes; for such properties in any subject as do not essentially belong to it, as whiteness in paper; and all qualities indiscriminately are termed accidents, in opposition to substance, as hardness, bitterness, smoothness, &c.

ACCIDENT, in *Grammar*, denotes any property of a word which is not essential to the definition of it. Whatever its meaning may be, it is either primitive or derivative, simple or compound, which are said to be its accidents. So the accidents of a noun are gender, number, and flection, and the accident of an adjective is comparison. See GRAMMAR.

ACCIDENTAL COLOURS, are those which are produced by the continued action of light upon the eye. If a small square of red paper be placed upon a white ground, a border of light green, surrounding the red square, is perceived. If the eye be removed from the red square, and directed to another part of the white ground, a square of light green, inclining somewhat to blue, and of the same size with the red square, is distinctly perceptible. This imaginary green colour is the accidental colour of the red; and its impression remains upon the eye, till it is effaced by impressions from other objects. Buffon, who first prosecuted this curious investigation, made similar experiments with squares of different colours, all of which were placed on a white ground, excepting the white square, which required a black ground; and he found that black is the accidental colour of white; white, that of black; red, that of blue; purple, that of green; blue, that of yellow, and green, that of red.

ACCIPENSER, or STURGEON, a genus of fishes belonging to the order *Cartilaginei*. See ICHTHYOLOGY.

ACCIPITER, signified, among the Romans, a hawk, which was regarded as a bird of a bad omen, on account of its being extremely carnivorous; although we are informed by Pliny, that in the case of marriage it was looked upon as a bird of a favourable omen, as it never devours the hearts of other birds, thereby intimating, that no differences in the connubial state ought to reach the heart. It was worshiped as a deity by the inhabitants of Tentyra, an island in the river Nile.

ACCIPITRES, the first order of birds in the system of Linnæus. See ORNITHOLOGY.

ACCLAMATION, a confused noise or shout, is the manner in which the public usually express their approbation or applause; but, in a more limited acceptation, it denotes a certain form of words, uttered with great vehemence, and in a kind of musical tone. Acclamation is distinguished from applause; the former is an expression of approbation by the voice, the latter by the hands. Applause was only bestowed on those who were present, and it was confined to men; but acclamation was given to the absent, and sometimes extended to women; and it was often accompanied with applause.

Acclamations formed a remarkable feature in the manners of the ancients, and they were of different kinds, as nuptial, military, theatrical, &c. In the nuptial ceremonies of the Greeks and Romans, acclamations were exhibited on the evening of the marriage, and the morning after, in the form of songs, in which the praises of the newly-married party were celebrated. Military acclamations were employed by the Roman armies at the election of their commanders; and in the moment of engaging the enemy, they shouted out, *Victory!* A similar practice obtained among the Greeks; and, it may be added, has prevailed both among ancient and modern nations. At the conclusion of a war, the victorious army extolled the praises of their leader; and on the return of the army, while they proceeded to deposit in the capital the spoils they had taken, their acclamations were re-echoed by the citizens. The theatrical acclamations of the Romans, which, in the earlier ages of the Commonwealth, were simple expressions of approbation and applause, became afterwards confused and disorderly shouts, and were at last converted into a kind of regular concert. This form of musical acclamation was known in the time of Augustus; it was greatly improved by Nero, who seems to have appointed a master of his band, which consisted of 5000 soldiers, who, on a given signal, began to chant his praise, which was repeated by the spectators. Acclamations were also given to the children of emperors, to favourites, and magistrates who presided at the public games. Similar expressions of approbation and applause were introduced into the Roman senate, and were exhibited on account of the election and proclamations of the emperors. Among both Greeks and Romans, it was not unusual to hold public assemblies, to hear the works of their poets and other authors recited; and those who were anxious for reputation had measures preconcerted that the acclamations should be loud and general. The solemn assemblies of the church were not exempted from this tumultuous manner of expressing approbation; but the violation of the solemnity usually attached to religious duties was at last suppressed.

It is quite unnecessary to add, what is known to every reader, that the different kinds of acclamation, excepting the last, are very prevalent in modern times—so prevalent, indeed, that they seem to form an essential part of many of our popular assemblies.

ACCOLADE, a certain ceremony, anciently observed in conferring knighthood; but concerning its precise nature, the opinions of antiquarians are not agreed. While some suppose, that it signified the embrace or kiss which princes gave to the new knight, as a mark of regard, and hence the origin of the word, which implies embracing, or taking around the neck,—others think, that it means a blow on the chine or back part of the neck, on the same occasion. The kings of France, in the early part of the history of that nation, conferred the gilt shoulder belt, by kissing the knights on the left cheek. The blow was in use among the ancient Normans. In this manner, William the Conqueror conferred the honour of knighthood upon his son. The blow was, at first, given with the naked fist, for which a stroke with the flat side of a sword was afterwards substituted.

ACCOMMODATION, is the application of one thing or event, by analogy, to another, in which some real or supposed resemblance exists. This term is chiefly applied to the interpretation of one part of Scripture by means of another; and, as might be expected, commentators are by no means agreed to what extent this principle of accommodation ought to be carried in the explanation of sacred history. According to the views of some authors, a prophecy of Scripture is said to be directly fulfilled, when the event foretold actually happens; and it is said to be indirectly fulfilled, when an event happens to any place or people similar to what befel another at a former period. In this latter sense, the prophecy or passage containing it referred to, is said to be applied by way of accommodation. An example of this kind is taken from the words of Isaiah, which were spoken to the people of his own time, and are said to be fulfilled in those who lived in the time of our Saviour, and are accommodated to them: "Ye hypocrites, well did Isaias prophecy of you, saying, This people draweth nigh unto me with their mouth, and honoureth me with their lips, but their heart is far from me." The same words were afterwards addressed, or accommodated by St Paul, to the Jews of his time. It has been asserted by some, that the rites and observances of the ceremonial law were of Egyptian origin, and were thus accommodated by Moses to the peculiar views and modes of thinking among the Israelites; and it is farther asserted, that the primitive church applied or accommodated many Jewish and heathen ceremonies to the system of Christian worship.

ACCOMPANIMENT, in *Music*, denotes the instruments which accompany a voice in the performance of any composition, to add to its general effect. Accompaniments are employed on the stage, as well as in the choir, and in recitative as well as in song. In modern times, the accompaniment is a different part from the song. Accompaniments were likewise employed among the ancients; and, in the theatre, it would appear that a different set of instruments was adapted to the chorus from that which accompanied the recitative. It is generally supposed, that the ancient accompaniment consisted only in playing in octave; although some think that a passage in Plato implies that actual symphony, or music in parts, was performed.

ACCOMPLICE, a person who is associated with another in the commission of a crime. By the general rule of law, the accomplice is subjected to the same punishment with the principal offender; and, according to the law of Scotland, his evidence against associates is not admitted, excepting in cases of treason, secret crimes, and some others, which are specified in the statute; but to remove every motive to give false testimony, he receives a full pardon before his evidence is required.

ACCUBATION, derived from a word which signifies to *lie down*, is a posture of the body, between sitting and lying, and it is generally applied to the posture of the Greeks and Romans at meals. It was introduced by the Greeks, and from them was adopted by the Romans; for, in the earlier periods of the republic, this practice was unknown. A Roman meal was conducted in the following manner: A low round table was placed in the dining-room, and around it two couches, called *biclinium*, or three, *triclinium*, were arranged. These couches were covered with a kind of bed-clothes, and furnished with quilts and pillows, for the accommodation of the guests. Three persons usually reclined on each couch. They lay on their left sides, with their heads on the pillow, or on the left arm, while the back was supported by cushions. The head of the second was placed near the breast of the first, separated by a pillow; and the third person was in the same relative situation with the second. The middle place was regarded as the most honourable. Before the guests came to table, they put on a dining garment, and pulled off their shoes or slippers, that the couch might not be soiled.

ACCUSATION, a charge brought against a person supposed to be guilty of some crime, at the suit of a private individual, or of a public prosecutor. Among the Romans, there was no public prosecutor; private persons, whether aggrieved or not, or otherwise interested, might prosecute for public crimes. In Britain, all accusations for public crimes are made at the suit of the crown, or of private parties who are interested or aggrieved. According to the English form of criminal procedure, the case of a person charged with a crime is investigated by the grand jury before he is put upon his trial. This form of proceeding is only observed, in Scotland, in cases of high treason. In all others which come before the supreme criminal court, the Lord Advocate is the public prosecutor, and in the inferior courts the procurator-fiscal; and if they should think proper to decline to bring the accused to trial, the private party aggrieved, with the concurrence of the public accuser, which must be granted, may institute a criminal action. See Law.

ACCUSATIVE, is the fourth case of Latin nouns, by which the termination of motion or action, or the connection between the agent and the object acted upon, is expressed. Thus, *Ille amat Deum*, He loves God; in which the action of loving proceeds from the agent, and terminates in, or is exerted towards God. See Grammar.

ACEPHALI, from a Greek word, signifying *without a head*, is the denomination of certain heretical sects who had no head or leader. These sects appeared in the fifth century. Some maintained that the body of Christ was incorruptible before the resurrection; others held a contrary opinion; and, while some asserted that there are three distinct natures in the Trinity, others believed that our Saviour was ignorant of some things. Each of these sects was characterised by distinctive appellations. A similar denomination was given to bishops who were exempted from the jurisdiction of their patriarch.

ACER, the maple or sycamore tree, a genus of plants belonging to the class Polygamia.

ACERRA, in *Antiquity*, denotes an altar which was constructed by the Romans in the apartment of a person deceased; and, on this altar, incense was burned till the time of burial. The original intention of this custom, it is supposed, was to conceal or destroy infectious smells; but it seems to have been converted into an expensive funeral ceremony; for, by the laws of the twelve tables, the practice is prohibited. The same word corresponds with *thuribulum* and *pyxis*, and denotes the small pot in which the incense and perfumes were burnt. It corresponds also with the *censer* of the Jews, and the *incense-pots* of Roman Catholics.

Among the Chinese, a custom similar to that of the Romans prevails at this day. A room is decorated with mourning; an altar is erected, on which the image of the deceased is placed; and all who approach to it bow four times, and offer oblations and perfumes.

ACETATES, in *Chemistry*, are salts formed of acetic acid and alkaline, earthy, or metallic bases. See Chemistry, *Index*.

ACETIC ACID, in *Chemistry*, a production of vegetable fermentation, corresponding with radical or distilled vinegar, and existing ready formed in some plants. See CHEMISTRY, *Index*.

ACHÆANS, a people of Greece, who inhabited ACHAIA *propria*, a district or province of Peloponnesus. The name is derived from Achæus, the son of a king of Thessaly, who was exiled from his own kingdom, and fled to Laconia, a province of Peloponnesus. His descendants drove the Ionians from Achaia, and seized their kingdom, which consisted chiefly of twelve cities, with no large revenues, and no great extent of territory. A republican form of government was established, wise laws were framed, and their administration was entrusted to upright and prudent magistrates. Firm, and united within itself, feared and respected by its neighbours, this small state continued to flourish and preserve its liberty and independence till the time of Alexander the Great, when it was distracted and weakened by jealousies and political dissensions, and became an easy prey to a foreign yoke, or a fit subject of oppression to domestic tyranny.

In the 280th year before the Christian era, when Pyrrhus invaded Italy, the Achæans recovered their independence; the tyrants were banished, the ancient league was renewed; new states were united under it; and the whole of Greece, excepting the Lacedæmonian territory, included. A public council or assembly was formed, consisting of deputies from each state, and met twice annually for the purpose of managing the affairs of the commonwealth. The president of this assembly was the commander of the army.

The Lacedæmonians, the rival neighbours of the Achæans, were the first to disturb their tranquillity. To resist their power, they were forced to form an alliance with Philip, king of Macedon, by whose aid they were successfully supported, and peace was established. But when the Achæans declined to promote the ambitious views of the Macedonian monarch, he became their determined enemy. This conduct led them to form an alliance with the Romans against Philip; and when the war was finished, they obtained possession of Corinth, and were again permitted to resume their ancient constitution. Nine years afterwards, the city of Lacedæmon was conquered, and became part of the Achæan confederacy. The Achæan state was now the most powerful of any in Greece, and it was greatly respected by all surrounding nations. But it was soon after disunited and enfeebled by internal dissensions; and becoming an object of jealousy to the ambitious views of the Romans, it was invaded by that people. In the 146th year before the Christian era, Mummius, the Roman general, defeated the Achæans, and plundered and burnt the rich city of Corinth; soon after which the celebrated confederacy was dissolved, and Greece became a Roman province.

ACHAIA, a name under which early writers and poets seem to have included the whole of Greece. In the times of the Roman state, this name was applied to the whole territory which constituted the Achæan league; when that league was dissolved, Greece was divided by the Romans into two provinces; one including Macedonia and Thessaly, and the other Achaia, which comprehended all the other states of Greece. Achaia Proper is limited to a small district of Peloponnesus, extending westward along the bay of Corinth, and bounded by the Ionian sea. The modern name is *Romania Alta*.

ACHEEN, ACHE, or ACHEN, a kingdom in the north-west of the island of Sumatra. See SUMATRA.

ACHILLÆA, yarrow, milfoil or sneezewort, in *Botany*, a genus of plants belonging to the Syngenesia class.

ACHILLEID, or ACHILLEIS, the name of a poem, in which the author, Statius, proposed to celebrate the life and adventures of Achilles; but he died before he proceeded farther than the infancy and education of his hero.

ACHILLES, one of the most celebrated heroes of ancient Greece, was the son of Peleus and Thetis, and was born at Phthia in Thessaly. Innumerable fables are related of this hero. To render him invulnerable, his mother immersed him in the river Styx; and it was expected that no wound could be inflicted, excepting on the heel by which he was held; but this supposed charm was not effectual, for he was wounded in the arm by a lance, in battle with the Trojans. Achilles was entrusted to the care of the centaur Chiron, to be instructed in horsemanship and martial exercises; and, to fit him to bear toil and fatigue, he was fed with honey, and the marrow of lions and wild boars. His mother, Thetis, endeavoured to keep him from the siege of Troy, by disguising him in female apparel, and concealing him at the court of Lycomedes. He was discovered by Ulysses, and persuaded to follow the Greeks, among whom he greatly distinguished himself by his bravery and heroism; but being disgusted with Agamemnon for the loss of Briseis, retired from the camp, and nothing could rouse him but the spirit of resentment to revenge the death of his friend Patroclus. In an engagement with the Trojans, he slew Hector, and dragged the dead body, fastened to his chariot, thrice round the walls of Troy. While Achilles was in the temple, treating about his marriage with Philoxena, the daughter of Priam, he was wounded in the heel by Paris, of which wound he died, and was buried in the promontory of Sigæum. After the fall of Troy, in obedience to the dying request of Achilles, the Greeks sacrificed Philoxena on his tomb, that he might enjoy her company in the Elysian fields. When Alexander the Great visited the tomb of Achilles, he placed a crown upon it, in honour of the Grecian hero, and said, "Achilles was happy in having, during his life, such a friend as Patroclus, and, after his death, a poet like Homer." The death of Achilles happened about 1183 years before the Christian era.

ACHMIM, the ancient Chemmis and Panopolis, is a celebrated city of Upper Egypt, and is situated on the eastern bank of the Nile. Abulfeda, a writer in the beginning of the fourteenth century, describes Achmim as a large town, and its immense temple as one of the most splendid monuments of antiquity. This temple, the ruins of which afford ample proof of its former magnificence, is without the limits of the present town. The stones of which it was constructed were of enormous size. Some have been removed to be employed in the construction of a mosque, some are heaped up in the squares of the town, and others, whose magnitude has defied the efforts of modern ingenuity to displace them, remain as a memorial to distant ages of a spot which the sublime genius of ancient architecture had rendered sacred. Many of the stones are covered with hieroglyphic figures. On one stone, four concentric circles are inscribed in a square. The innermost circle contains the figure of the sun; the next circle is divided into twelve parts, on which twelve birds are represented; the third, divided in the same way, exhibits the figures of twelve animals; and on the fourth, which has no divisions, twelve human figures appear. M. Savary, from whom this description is taken, supposes that these divisions and figures represent the twelve months of the year, and the twelve signs of the zodiac; and this seems probable, from the Egyptians being the first who thus divided the year. The angles of the square are occupied by the four seasons, and on each side is seen a globe with wings. The French traveller thinks it probable, that this temple was dedicated to the sun, and that the whole of the hieroglyphics mark his passage into the signs of the zodiac, and his annual revolution.

Achmim is at present under the dominion of an Arab prince; and, though greatly circumscribed in extent, the streets are spacious and clean, and a regular police is established. Agriculture and commerce are prosperous, and the manufacture of cotton stuffs and pottery is considerable. But the most extraordinary object of the traveller's attention, is what may be denominated the serpent establishment, for the cure of diseases. More than one hundred years ago, Scheick Haridi died at this place, and was so much venerated for his sanctity by the Mahometans, that they erected a splendid monument to his memory, to which people flocked from all quarters, to offer up prayers. A priest, taking advantage of their credulity, persuaded them that Haridi's soul had entered into the body of one of those harmless serpents, which are abundant in the country. He taught it to obey his voice, and to perform wonderful tricks, and at last pretended to cure all diseases. The serpent was confined to the tomb of Haridi, and produced only on proper occasions. The priest who had established this lucrative trade, found successors who were equally disposed to persevere in it, and who saw the advantage of impressing a belief of the serpent's immortality, of which they ventured to exhibit a public proof. The serpent was produced, and cut in pieces, in presence of the Emir, and placed for two hours under a vase; and when the vase was removed, a serpent, exactly the same in size and colour, appeared. This miraculous event was spread abroad, greatly increased the reputation of the serpent, and attracted crowds of suppliants. When the serpent appears at the bottom of the tomb, and approaches the suppliant, it is regarded as a sign that the disease will be removed; but it is understood that a present has been previously offered, and is expected to be proportioned to the rank and wealth of those who solicit the serpent's healing influence.

ACHRADINA, one of the four cities or divisions of Syracuse, is represented as the most extensive and most beautiful part of that celebrated city. The public buildings were of the most magnificent description, among which are enumerated the forum, with its splendid porticos; a prytaneum of remarkable elegance; a spacious senate-house; and a superb temple, dedicated to Jupiter Olympius.

ACHRAS, or SAPOTA PLUM, a genus of plants belonging to the Hexandria class.

ACHROMATIC, a Greek word, which is expressive of want of colour, is a term applied to telescopes which are so constructed as to remedy the aberration of the rays of light, whether it arise from the figure of the lens or speculum, or from the unequal refrangibility of the rays. See OPTICS.

ACIDS, in *Chemistry*, an important class of substances, which, when applied to the tongue, excite the sensation called *sour*; which change the blue colours of vegetables to red; unite with water, almost in all proportions; and combine with alkalies, earths, and metallic oxides, forming compounds which are denominated *salts*. See CHEMISTRY.

ACIS, in *Mythology*, the son of Faunus and the nymph Simaethis, was a beautiful shepherd of Sicily, and beloved by Galatea. Polyphemus, one of the giants of Ætna, stung with jealousy and resentment, seized him, and dashed out his brains against a rock, after which he was changed into a river, which took his name; but, according to the Sicilian authors, Acis was a king of this part of the island, and was slain by Polyphemus, from a similar motive.

ACIS, a river of Sicily, greatly celebrated by the poets, which issues from a cold spring at the foot of mount Ætna. Its waters, which were held sacred by the Sicilian shepherds, and were famous for their sweetness and salubrity, are now impregnated with sulphureous vapours. The modern name of this river is Aci or Jaci.

ACOEMETÆ, the name of a religious sect which arose in the fifth century, and is expressive of their practice of keeping up constant worship in their churches; the rule of which is derived from the apostolic precept,—*pray without ceasing*. To observe the literal import of this precept, the establishment was divided into three parties, one of which was always occupied in religious duties, so that the church service suffered no interruption.

ACONITUM, ACONITE, wolfsbane, or monkshood, a genus of plants belonging to the Polyandria class. Winter aconite is a species of the genus Helleborus.

ACORUS, sweet flag, or sweet-smelling rush, a genus of plants belonging to the Hexandria class; one of the species of which is sometimes employed in medicine.

ACORN, the fruit of the oak-tree; in some countries, during scarcity, is employed as food, while in others, such is the diversity or caprice of taste and fashion, it is introduced at table, and considered a delicate part of the desert.

ACOSTA, URIEL, a learned Portuguese, the history of whose life presents a singular picture of wavering principles and versatile opinions, and affords a useful lesson of the fatal consequences of unsteady conduct. Acosta was born at Oporto, about the end of the sixteenth century. His father was descended from a Jewish family, but had embraced the Roman Catholic faith, in which also the son was educated. He received a liberal education, made considerable progress in science, and at last devoted himself to the study of law. At an early age he had accustomed himself to look on the dark side of things, and at last gloomy forebodings of futurity seemed entirely to take possession of his soul. Still, however, in the midst of religious doubts and mental perplexities, he continued his professional studies, and was appointed, in his twenty-fifth year, treasurer in a collegiate church. But the more he examined the religious system in which he was educated, the more he was dissatisfied with its peculiar tenets, and the more he dreaded the eternal fate of his soul. As his family were of Jewish extraction, it seems probable that he was not altogether free from some remains of the old leaven; but, whatever influence this might have on the change which he contemplated, he began to study Moses and the prophets; the consequence of which was, a determination to become a convert to the Jewish religion. The vigilance and zeal of those who superintend the propagation and establishment of the Roman Catholic faith, did not permit him to make a public avowal of such a change in the country where he now resided. Resolved to surmount every difficulty that opposed the accomplishment of his purpose, he resigned his office; accompanied by his mother and brothers he removed to Holland; and having submitted to the requisite ceremonies of the Jewish law, they were all admitted members of the synagogue of Amsterdam. Gabriel, his former name, was exchanged for that of Uriel. But this change in his religious belief had not the desired effect in quieting the unsettled state of his mind; new scruples arose, and new doubts, which it could not solve, presented themselves in rapid succession. He was little guided by prudence in expressing his opinion on those points on which his mind was not satisfied; and even had no hesitation in using violent invectives against those who supported the peculiar tenets which he did not approve. Sentence of excommunication was pronounced against him: and it was executed with such vigilance and severity, that even his own brothers were prohibited from addressing him in the streets. He published a book in his own justification; soon after which, a treatise on the immortality of the soul, in which Acosta was reviled as an atheist, appeared. This produced an answer, in which he attempted to confute that doctrine. Popular clamour was now excited against him; he was insulted in the streets; and he was not safe in his house, from the violence of the multitude. The irritated Jews applied to the civil power, and declared him the enemy of all religion. He was thrown into prison, subjected to a heavy pecuniary penalty, and all the copies of his works were seized and destroyed. After this severe persecution, and fifteen years exclusion from the Jewish church, he subscribed a formal recantation of his errors, and was again admitted into its bosom. But a few days only had elapsed after this event, when he was charged by his nephew with want of conformity to the laws of the synagogue in meats and drinks. He was again excommunicated. Having passed seven years more of his life, in some measure as an outcast from society, and being encouraged to hope for some remission of the severity of the discipline required, he declared his willingness to submit to the sentence of the synagogue. But he was deceived; the most rigorous penance was enforced; he was subjected to the ignominious punishment of receiving thirty-nine stripes; and he was laid on his back at the door of the synagogue, that every one might pass over him. Unrelenting persecution made Acosta desperate; he resolved on self-destruction, which he afterwards perpetrated; but he previously attempted to destroy his principal enemy, by shooting him with a pistol as he passed his house. This attempt failed. He instantly shut the door, and having another pistol in readiness, shot himself. This event happened at Amsterdam, about the year 1645. A posthumous work of Acosta, entitled "*Exemplar humanæ vitæ*," or a specimen of human life, which is supposed to have been written a short time before his death, was published by Limborch, with a refutation and criticism annexed. The strange character which Acosta exhibited, his love of controversy, and his vacillating temper in matters of religion, may perhaps be partly ascribed to the intolerant spirit of the times, but chiefly, it would appear, to a certain degree of alienation of mind.

ACOUSTICS.

Acoustics, a term derived from the Greek word to hear, is used to denote that science which treats of the nature, properties, and laws of sound. It has been divided, like the kindred science of Optics, into Diacoustics and Catacoustics—the former, respecting those sounds which come directly from the sounding body to the ear; and the latter, those which are reflected from other bodies before they reach that organ. The distinction, though undoubtedly just, obviously involves a theory, and is perhaps improper, therefore, in the commencement of an elementary treatise, more especially when the science itself is in a state of infancy. The correct division of any science must necessarily follow the acquisition of a knowledge of the materials composing it, a proper enumeration of the most important facts, and a cautious induction of general laws from them.

Sound, to use the language of Dr Johnson, is that which is perceived by the ear. This, indeed, is scarcely a logical definition, properly so called; but it sufficiently implies, though it does not express, what is meant by the word, in the judgment of all who have the faculty of hearing. It must be allowed, too, the merit of accuracy, as well in restriction as in comprehension. The ear perceives nothing but sound, and is the only organ which does perceive it.

The first part of this assertion requires no other proof, than an appeal to every man's experience. A seeming objection to the latter clause, arising from the circumstance of certain sounds being perceived when the bodies producing them are applied to the forehead, teeth, &c., although the ears be stopped, will be found, on inquiry, to have no real weight. In all of these cases, the organ of hearing is operated on through the medium of bones, membranes, cavities, &c.; for it is not essential to the perception of sound, that the external ear be affected, though this is materially conducive to its perfect discriminating power. The case of Mitchell, a boy born blind and deaf, whose history has been given by Mr Dugald Stewart, in a paper read before the Royal Society of Edinburgh, does not suggest any thing against this explanation. The disposition he has shewn, since infancy, to ring or strike objects against his teeth, may be accounted for on two principles, quite consistent with it. Either the nerves of hearing are not entirely wanting or useless in his case, so that he acquires some information by them,—or his teeth, by a process little or not at all attended to by others, furnish him with sensations, by means of which he perceives the relative hardness, or some other properties of bodies. This latter is probably the more correct conclusion, and might be amply supported by analogies drawn from the histories of many other individuals, who have been deficient in an organ of sense.

The ear alone, then, perceives sounds, and nothing but sounds. These are very various, and, either by the constitution of our nature, or the result of experience founded on it, communicate to us very different sensations, emotions, and information. They are signs, in fact, by which we learn to distinguish a multiplicity of objects, and that in so accurate a manner, that, to take one example for many, we can recognise a friend by his voice, without any intimation to our other senses, amongst a vast number of persons, all using the same language and speaking in the same tone. The power of which this organ may become possessed, in marking differences, as in the case of the blind, who are led, of necessity, to cultivate it, is scarcely conceivable by those who confine themselves to its more common attainments, and make up the deficiency by the other senses. How far its structure is accommodated to the purposes for which it is manifestly designed, and the manner in which it is affected by the variety in the tones and strength of the sounds it is subjected to, fall to be discussed elsewhere. The business of this article is quite distinct; and it is sufficiently important, not to require the interest of anatomical demonstrations, or the disquisitions of physiology, as an incitement to attention. We shall remark, however, as necessary to guard some readers against one bane of true philosophy and just logic, the drawing general conclusions from particular premises, that the ear differs so considerably in different orders of animals, that it is extremely difficult, if not impossible, to say what parts of its mechanism are essential to the faculty of hearing in general, or to what peculiar purposes the specific modifications of individuals are subservient.

Phenomena of Sound.—However constructed, it is certain the ear is requisite for the perception of sound. Let us now inquire what it is that produces sound, or, to speak more cautiously, what are the occasions on which the phenomena of sound take place? The investigation may be conducted in the following manner. A rumbling kind of noise attracts our attention: We remember to have heard something like it, when a cart passed over the street. We infer this to be the case at present, and we are not mistaken. Another sound is heard, similar to what we have often perceived when a certain rope was pulled in an adjoining room, and that rope, we know, is connected with a bell, which is made to ring on such occasions. Presently a confused noise occurs, for which we can assign no precise reason: But we refer it, by a rapid process of reasoning on past experience, to the fall of a heavy body on the floor above us. The conclusion is perfectly correct. Now follows an agreeable succession of soft and delicate sounds, which we ascribe, with equal confidence and truth, to a musical instrument called a hand-organ, that is played on by a man at a short distance from us. Immediately a beggar boy solicits charity in a whining tone of voice; and, on observing him, we remark his lips to be moving. In all of these cases, and in a vast variety of others, we discover, that the bodies from which the sounds appear to proceed, have been subjected to some kind of motion. Hence, after multiplying our observations, and finding no exception, we come to the conclusion, that motion is essential to the production of sound, or, at least, that there is a constant conjunction between sound and some sort or degree of motion in the body whence it proceeds. All bodies, we soon remark, do not give out sound with equal ease. Their nature, shape, and situation, appear to have some influence, both on the comparative facility and the kind of sound. The metals, especially, if in certain degrees of thinness, in certain shapes and magnitudes, are remarkably sonorous; glass, china, and stone-ware, have the same property. Other substances, and even the same substances in different states, or placed in peculiar circumstances, are made to sound with much greater difficulty, and the sounds which proceed from them are of shorter duration. We have instances of this kind, in earth, sand, most masses of stone, woollen, and other cloths, &c. Even the sonorous bodies before mentioned, when filled with these substances, or caused to press closely and for a considerable portion of their magnitude upon them, are rendered less fit for the production of sound than they were before. A few observations, and some familiar experiments soon point out some of the conditions on which these differences depend, or with which, at least, they are invariably united.

Having ascertained that sound is always connected with motion, it seems reasonable to enquire, what is the sort of motion most favourable for its production, or that is constantly associated with it. Let us, therefore, examine the states of those bodies which are remarkable for the freedom and duration of their sounds, at such times as they are producing them. We have a singular example immediately before us, that promises a little aid in our research. A long knife, spatula, or paper-folder, being pressed on the table by the fingers of one hand placed within an inch or two of the point, and in such a manner that the remainder of the blade may project beyond the edge of the table, immediately gives out a very peculiar and somewhat musical sound, as soon as the handle is pushed downwards by the other hand, and then allowed to spring up to its former position. During the continuance of the sound, and as often as it is produced, the fingers, by which the blade is still pressed on the table, experience a tremulous motion. We discover also, that as we either apply more fingers to the blade or remove some of them from it, vary the force by which we press it on the table, diminish or increase the quantity of the blade thus pressed, &c. we alter both the sounds produced and the tremulous motions accompanying them. This simple instrument, in short, may be so managed, and has been so managed, as to produce several notes, and to emulate, if not excel, most of the music of savages. Again, if a thin but large plate of copper or iron be struck in such a manner as to yield a durable sound, we shall easily perceive, by a finger gently applied to it, that it undergoes a very similar action. This may even be discovered by the eye, if some light substance, such as sand or dust, be strewed over its surface. When a glass vessel, partly filled with water, is made to sound by a wet finger passing artfully round the brim, as in the case of the musical glasses, we may distinctly observe an undulating or trembling appearance of the surface of the water, always when the sound takes place; and this motion, it cannot be doubted, is communicated to it by the glass, to which alone the moving force is originally applied. Minnows confined in the vessel, as we have sometimes noticed, appear to be sensible either of the sound or the motion thus produced. The atmospherical air contained in sonorous bodies of a particular shape, may be put into some corresponding motion by the same or different means. Thus, when a large bell is rung, or caused to sound by a blow, a person near enough to its mouth is quite sensible of a peculiar agitation of the air around him; and in some cases, as of bells of an enormous size, the vibrations of the atmosphere are so great as to prove very unpleasant. When a gong, or any such instrument, is sounded, the hand applied to the opening, even at some distance from the edges, is sensible of a tremor being communicated to it. In all such cases, and a thousand might be mentioned, it is most manifest, that the motion with which sound is, somehow or other, connected, is of a tremulous or vibratory nature, and that it is not confined to the body from which the sound seems to proceed, but is propagated to the contained fluid and ambient atmosphere.

That the nature of the body put into this sort of motion is comparatively of little consequence as to the production of sound, is proved by the fact, that every substance capable of being brought into a state of tension or elasticity, so as to admit of vibrations, is capable also of giving out sound. The nature of the substance must, of course, be considered so far, as that the proper condition for its vibrations may be effected, as this varies in different substances; but further it is unimportant in the general phenomena now considered. Metals, and other hard substances, must be in the state of thin pieces, or of hollow shapes, or in certain situations. Soft and very flexible substances, on the other hand, require to be stretched, or drawn tight. Hair, silk, catgut, strings of various materials, metallic wires, &c. when thus treated, become sonorous in so remarkable a degree as to be peculiarly adapted, and to be commonly employed, for musical instruments. The last class of substances we have mentioned, deserves still greater attention, as affording an excellent illustration of the conclusion we have already arrived at, as to the connection between sound and vibration, and as giving some curious information with regard to the modifying effect of changes in the latter, on the kinds and duration of the former. The examination of the action and musical product of strings, in fact, has brought Acoustics within the range of mathematical reasoning, and raised it, in consequence, to a place among the accurate sciences. It has not proved ungrateful for the elevation;—but, on the contrary, by suggesting some improvements and facilities in calculation, has afforded another example of that mutual subserviency of interests, by which the progress of the sciences has been so rapidly accelerated in modern times.

We shall now advert to the most important facts respecting this branch of our subject, and state, with as much simplicity as possible, what are the conclusions to which they lead. First, however, it is necessary to apprise the reader, that sounds are said to have strength and tone, and that these words mean very different qualities. To the first we apply the epithets, loud, soft, forcible, gentle, &c.; the latter we denominate high or low, sharp or flat, acute or grave, &c.; and by a little attention to the application of these terms, the qualities themselves will be better understood than by any definition we could assign. The distinction is of some importance. Lord Bacon seems to allude to it when he says, "The strength of a voice or sound makes a difference in the loudness or softness, but not in the tone." Tone, pitch, key, are often used synonymously.

Fundamental tone.—If a string that is stretched between two points, or that is suspended from a peg, having a weight attached to the lower end, be drawn a little out of the perpendicular line, and then let go so that it may return to its former position, it will be observed to vibrate several times on both sides of that position. During its vibration it also emits sound, varying in strength from greater to less as the vibrations become fainter, and at last totally ceasing together with the vibrations. If all circumstances remain the same, the sound thus produced has always the same tone, though it differ much in point of strength. This is generally denominated the *fundamental sound or tone* of the string. All strings have not the same fundamental tone; and, even the same string varied, as we shall immediately specify, is capable of giving out very different tones. Thus, if it be made longer or shorter, thicker or smaller, or be stretched by a greater or less weight or force, its sound will be altered. Universally, changes in any of these three circumstances, the length, weight, and tension of the string, are accompanied with corresponding changes in the sounds produced. What these changes are, may be briefly stated. If we diminish the length, we heighten the tone, that is, make it sharper. The same effect is caused by reducing the weight of the string, or by increasing the force that distends it. On the contrary, lengthening the string, increasing its weight, and diminishing its tension, make the tone deeper, *i. e.* more grave. Obviously, therefore, a difference in any two of these circumstances, may be compensated for by a variation of the third, provided we are acquainted with the exact proportions in which they are related to each other; and hence we can cause several strings either to give out the same notes, or to sound very different ones. On this fact is founded the construction of most of the stringed instruments used in music.

Now, the only particular in which these three modifying circumstances are found to agree, or, in other words, the only thing common to them all, is the power of varying the time in which a vibration of the string takes place. This is a most important observation, as it subjects the vibrations of musical strings to a calculation similar to that used in the case of pendulums, and of course gives rise to certain rules, or formulæ, which are of great utility in the practice of Acoustics. In alluding to these, which it is necessary we should do, we shall study to avoid mathematical intricacies either in substance or form, as our object is not to appear learned, but to be extensively useful; for which purpose, to be readily comprehended, is an essential condition.

The motion of any part of a string, from a point where it has been drawn out of its original or quiescent position, to a corresponding point on the opposite side of that position, is called a single vibration; so also is the motion from this last point to the former one, or the return. Both together, that is, the motion of the string from its point of inflection to its return to it, after having reached a corresponding point on the opposite side of the plane of inflection, constitute what is denominated a double vibration. Perhaps the terms semivibration and vibration, would be more appropriate, as there does not appear to be good reason for varying from the language applied to the parallel case of pendulums. We shall not, however, contend for words, and therefore abide by the current expressions.

Harmonical curve.—Now, it is found, that the times of the vibrations of a string are always the same, whatever may be the distances to which it is inflected from its quiescent or initial position. The times, in other words, are independent of the distances, a string always accomplishing its vibrations in equal portions of time, whatever may be the amount of its departures on either side of its original position. The velocity, therefore, must be different, being greater in the larger distances and less in the smaller; and this may be made obvious to the eye, in the case of a string continuing for some time to sound the same tone, but becoming gradually fainter as its vibrations occupy less space. The tone is dependent, as we have said, on the time of the vibration. Whilst the vibration, therefore, is performed in the same time, the tone is the same; and *vice versa*, if the tone be the same, the vibrations are effected in the same time. These two things are inseparably connected. The distance, therefore, or space through which the string vibrates, like the weight of a pendulum, does not form an element in any mathematical expression of the time of the vibrations, which, accordingly, is stated in terms of the length of the string, its weight, its tension, and the velocity which a body acquires in falling, for a second of time, by the action of gravity. If we substitute letters or numbers, therefore, in place of these terms, we may obtain certain algebraical or arithmetical equations, constituting the problem of the musical chord, which agrees exactly with the results of experiments on strings whose vibrations admit of being numbered. The problem was first resolved, in an intricate manner certainly, by our countryman, Dr Brook Taylor, and afterwards more simply by the illustrious D'Alembert. The particular curve which a string must form in order that all its vibrations be isochronous, or performed in the same time, has been called, from the former gentleman, who ascertained it, the *Taylorean curve*, and sometimes, from its properties, the *Harmonical curve*. A knowledge of its nature unfolds all the intricacies of vibrating strings and aerial pulsations, and is consequently the very basis of musical science. We shall content ourselves at present with a few deductions from the formula above alluded to. If two strings have the same length and weight, their times of vibration will be inversely as the square roots of the forces stretching them; and the number or frequency of their vibrations will be directly as these square roots. If the length and tension be the same, the number of the vibrations will be inversely as the square roots of the weights of equal lengths of the strings. If the weight of equal portions and the tension be the same, the frequency will be inversely as the lengths. We can tell, therefore, the number of vibrations which a string will make in a second of time; and, as the tones are dependent on the times, we can determine them also, and compare them together, on mathematical principles.

Comparison of Sounds.—Having ascertained so much with respect to musical strings, we are obviously in possession of a measure to which we can refer the tones of other sonorous bodies; for the sound of any body can be compared with that of a string of known length, weight, and tension. On adjusting the latter to the former, so that the two may be in unison, we conclude, on the general principles now established, that the number of vibrations performed in a given time is equal in both cases. A well practised ear is quite competent to this adjustment in all cases; and occasionally some phenomena occur, of a very striking nature, to point it out, even to those persons who cannot boast of such an acquisition. We mean the consentaneous vibration and corresponding tone of two or more bodies in unison, if near to each other, when only one of them is touched so as to sound. For example, we have observed the human voice, when raised to a certain tone, to be accompanied by the sounding of a guitar-string that happened to be in unison with it. A drum, when beat on, will occasion the vibration of another drum at a distance, as may be seen by the motion of dust or sand put on it. The deep tones of an organ not unfrequently produce vibrations in the wooden forms used in church-pews. There are many other instances of the same sort. May not the inclination, sometimes scarcely resistable, which persons of a musical talent and voice feel to join in a concert, depend, in great degree, on some involuntary principle of a kindred nature?

The analogy between the vibrations of strings, and those of other sonorous bodies, is obviously greatest when the latter are brought into a state of tenuity and elasticity, so as most to correspond with the former. We have already specified wire. To this may be added rods, rings, cylinders, and thin plates of metal, membranes of any kind when drawn tight, in short, all bodies which can be brought into a state admitting vibrations, as strings do, on both sides of a fixed axis. Other bodies, however, nay, even the same bodies, by particular management, may be made to vibrate in a different way; viz. longitudinally, or from end to end; and some bodies, perhaps, scarcely ever vibrate in any other manner.

Here a new field of inquiry opens upon us. We can scarcely imagine, that the same laws which we have hitherto contemplated, will apply to circumstances apparently so widely different. The densities and elasticities of the bodies, not to mention the modes in which they may happen to be fixed during our examination, may reasonably be expected to require consideration, and, of course, to modify the formula used to denote the vibrations. Additional difficulties present themselves; and this part of Acoustics, in consequence of the comparatively recent and limited attention bestowed on it, is still very imperfectly understood. A few general observations are all we shall hazard on the subject.

Modifications of Sound.—The circumstances affecting the pitch or tone of bodies vibrating longitudinally, independent of the mode in which they are fixed, are conceived to be four; viz. their length, their specific gravity, their elasticity, and the rate at which this last quality is varied, by compression and expansion. The three first are principally concerned in the case of solid bodies, though not excluded from those of fluid and aerial bodies, to which, again, the last mentioned circumstance has almost an exclusive reference.

These modifying causes, it will readily be understood, do not all equally affect the tones of bodies. Generally, the tone is made acute by an increase of the elasticity of the sonorous body; and the diminution of the length and specific gravity has the same effect. The precise proportions are not easily determined; but it has been remarked, that a diminution of the length to one-half, of the specific gravity to one-fourth, and augmenting the elasticity four times, have nearly corresponding power. The length is commonly much easier varied than either of the other circumstances, and is more usually had recourse to. An increase of elasticity, indeed, is readily enough accomplished by an elevation of temperature. But this is confined to narrow limits, and cannot be used in general as a source of permanently heightened tone, at least to a great degree. We may see the effect of increased temperature to raise the tone, in the case of such instruments as the flute, hautbois, &c. When long played on, or held to the fire, they give out much sharper sounds, to the great vexation of violin performers, who frequently break their strings in attempting, by additional tension, to preserve the unison. The tightening of tambourines, drums, battle-doors, &c. by the application of heat, on the same principles, raises their tones.

As the different elastic fluids operated on in some of Mr Dalton's experiments were found to expand, and to suffer contraction, with the same increase or diminution of temperature, it is evident, that the last of the four circumstances enumerated may be assumed as equal, in the case of different bodies of this sort, at the same temperatures. These bodies, therefore, may be considered as differing in density only. The difference of temperature, however, is clearly an element in any expressions used to denote the relation subsisting between the same or different elastic fluids. Hitherto, we may notice, the utmost obscurity pervades this part of Acoustics, which, at best, perhaps, can only be considered as simply curious. That many singular, and, probably important facts, remain to be disclosed, however, may be confidently believed. Experience teaches us to be cautious in setting limits to discovery; and accident often reveals what no wisdom or science on the part of man could have possibly anticipated. A very striking fact, noticed, we believe, by Dr Higgins, may probably lead to results of no ordinary import. We allude to the peculiar sound occasioned by the combustion of a small stream of hydrogen gas, when surrounded by a glass or porcelain tube. This, as far as we know, has neither been satisfactorily explained, nor followed up by suitable experiments on other elastic fluids. The tones of bodies vibrating longitudinally, are ascertained to be more acute than those of the same bodies when vibrating laterally. We infer, therefore, that their vibrations are quicker in the former case, and, as they are not so loud, that they occupy less space. But it is, perhaps, impossible to determine the number of vibrations in these cases, especially in solids. Some conclusions have been ascertained, of a very general, but still a very useful nature. Two or three may be specified.

If any given body be either fixed or free at both extremities, the number of longitudinal vibrations performed by it in a second of time, will be the same; and consequently, on the general principle, the tone will also be the same. If it be free at one end, and fixed at the other, we must reduce its length one-half, in order to make it give out the same tone. The case of elastic fluids is similar, and hence, we establish a very important analogy between aerial pulsations and the longitudinal vibrations of solid bodies. It would perplex most readers, perhaps, to pursue the comparison throughout, and to apply the modifications which the different natures of the two classes of bodies require. Nor is it necessary to enter upon it for any practical purposes. We shall merely mention, therefore, that the column of air in a tube or wind instrument is to be considered as the sonorous body, and that its vibrations are occasioned by the alternation of condensed and rarified particles or layers throughout its length, whilst the whole is moved longitudinally by the original impelling cause. The fact noticed by Dr Higgins, to which we have already alluded, may be conceived to confirm this solution, and to be itself, in turn, explained by it.

Harmonics.—Thus far of the fundamental tone or sound of bodies, as connected with their vibrations, whether laterally or longitudinally. An additional fact, curious in itself, and presenting difficulties of a peculiar nature, leads us to the consideration of what have been termed *harmonics*. The fundamental tone is not the only sound given out by a musical string. On the contrary, this expression is used to discriminate it from other sounds, with which it is often, and, in some cases, invariably associated. To these additional sounds, from the circumstance of their concurrence with the fundamental note in the production of an agreeable effect on the ear, the term harmonics has been applied. Every ear, it ought to be remarked, cannot distinguish them. But a little attention will generally enable a person to obtain this power, particularly as to what are called the twelfth and seventeenth, the octave usually coalescing with the fundamental note, so as only to be discovered by a well practised observer, whereas the other two, which arise later, are easily enough detected. If the harmonic notes be very acute, they will not easily be recognised, as the ear is not familiar with their range of tone; on the other hand, where the fundamental note is extremely grave, it is apt to escape being noticed in the harmonics associated with it. The reason plainly is, that the ear, though it may be accommodated to a vast variety of tones, is commonly much more acquainted with those which are intermediate between the very high and the very low, and is consequently better able to compare them together.

We can scarcely imagine that these harmonics are dependent on any thing else than the principle to which, after a most unexceptionable induction, we refer the production of the fundamental tones. Nature, we may be allowed to say, is sparing in causes, and fruitful in effects, contrary to the puny wisdom and limited agency of man, who has to multiply his instruments, and vary his plans, in order to accomplish a small variety of purposes. On this presumption, then, we might even, *a priori*, decide, that these harmonics are regulated by the general laws of vibrations, which we have ascertained to exist in every case of the original or parent sound; that they are, in short, modifications of the greater vibrations of the strings. Experiment fully warrants this conclusion; and, accordingly, it may now be held as an authentic part of the science. The observations of Professor Robison, Dr Thomas Young, and others, put it beyond doubt, that besides the vibration of the whole string, on which the fundamental note depends, there take place several vibrations of parts of the string, either in the same or in different planes, and that these are the source of the fainter, but acute sounds, which we are now considering. Still it must be allowed, the subject has not received that elucidation which its curiosity, at least, would prompt one to desire. In concluding it, we shall briefly observe, that strings are not the only sonorous bodies which are capable of producing harmonics; for those bodies which vibrate longitudinally, and also wind instruments, have been discovered to yield such sounds. The experiments of Dr Chladni on the former, have afforded no slight confirmation of the views above stated, as to the connection of harmonics with subsidiary vibrations of the sonorous bodies. The secondary sounds of wind instruments may be traced to similar minute vibrations of the columns of air, from whose greater movements the fundamental sounds derive their origin. This last remark leads us to regard the atmospherical air as itself capable of vibrating, and, consequently, of giving out sound; and we may enquire, whether other fluids, elastic or nonelastic, may not produce similar effects? The subject has been partly anticipated already, but demands additional remarks.

The proposition, that all fluids, whether elastic or nonelastic, may be made to vibrate and to become instrumental in the production of sound, seems the just inference, from most extensive observation. We shall not specify particular examples. It is of more consequence, perhaps, to remark, that this proposition is, in fact, but part of a general conclusion, which every reader will be prepared to admit, on the ground of his own experience, in addition to what has been said, viz. that all bodies, by proper management, are capable of giving out sound; and that, in producing this effect, they suffer vibrations. Farther, it is an obvious deduction from this, in conjunction with a well known fact, that sound requires time to be propagated from one place to another, that the vibrations of the sounding body are first communicated to the adjoining portion of the ambient medium, thence to another portion, and so on successively, till it reach the ear of the observer. The impression there made, it will, at once, be conceived, excites the sensation of sound, and, according to its force, and kind, and frequency, occasions that variety of sensation which is so important in our intercourse with the external world. That the same medium between the sounding body and the ear is requisite for the production of this sensation, appears from the fact, that the sound of a bell, placed in the receiver of an air pump, becomes gradually more and more faint as the air is withdrawn, and, at last, is scarcely audible; it would, no doubt, be completely lost, if a perfect vacuum could be formed; and, on the admission of the air, the sound of the bell again becomes distinct.

That water conducts sound, is easily shewn, and must be known to most persons. Professor Robison made a decisive experiment on the subject. He immersed his head under water, at the distance of 1200 feet from a bell made to ring in the same medium. The sound of it reached him. Divers, a few feet under water, hear what is said to them. The sound occasioned by a stone struck forcibly on the bottom of a river or pond, can be perceived. The gurgling of rivulets, &c. may be referred to the same principle. A calm sea is known to convey sound to an immense distance. Thus, whales can frequently discover the boats that go in pursuit of them; and, accordingly, a breeze producing a ruffled sea, is preferred by the Greenland fishermen. *Lastly*, we may notice, that fishes are provided with organs of hearing, which would be useless if water did not convey sound; and they may, in fact, be easily perceived, at times, to be affected by it.

Certain solid bodies, it is well known, propagate sound with great rapidity, and that, apparently, without the medium of the air or any other fluid; and, universally, those solids answer the purpose best, which are most adapted to transmit impulses or vibrations. Metals are peculiarly fitted for it, but not all in the same degree; and, to these, may be added glass and wood, and many other substances. The experiment, as far as we know, has not been performed; but it cannot be doubted, that if the end of a rod were placed so as to be struck or scratched when under an exhausted receiver, it would vibrate, and consequently communicate sound at the other end, out of the receiver, as readily as in the open air. This experiment, and a similar one in the case of a condenser, both of which, we think, might easily be contrived, would go far, perhaps, to determine whether or not the tone or pitch of sonorous bodies continued unchanged in different degrees of density of the inclosed fluid.

Velocity of Sound.—The velocity of sound, as may easily be collected, from what we have already mentioned, is different in different media. The genius of Newton subjected it to calculation, at least in the most important case, that of the atmospherical air. His reasoning was not altogether unexceptionable, and his conclusion made the velocity less than what experiment proved it to be. On the whole, however, his principles have been confirmed; and a suggestion of La Place has pointed out a reason for the difference of results, founded on a chemical principle of known and very extensive agency, viz. the effect of the condensation of the aerial particles concerned in vibration, in giving out heat, and so increasing elasticity, or diminishing density. Newton's calculation brought out the velocity at 1057 feet *per* second. The experiments of Dr Halley determined it to be 1142; those of the Florentine academicians, 1148; of the French, 1109; Bianconi, so low as 903; Walker, so high, at one time, as 1526; and of others, very variously. The mean has been taken at 1130; and this tolerably well corresponds with La Place's suggestion in favour of Newton's hypothesis. Whatever estimate we take, it seems certain, that the velocity of sound through air, is the same as that of an impulse; and hence a confirmation of the opinion, so often stated, that sound and vibration are intimately connected. If additional support were needed, we have it afforded in the case of every substance through which we can trace the velocity of both. This, indeed, is so great, in general, and more particularly in the case of solids, that it is perhaps impossible to compare any of them together in this respect. One thing, however, is clearly to be ascertained, that the sound and the impulse are transmitted, *i. e.* proceed with equal or the very same velocity. On the whole, then, it seems absolutely impossible to hesitate for a moment, in admitting the general inference to which all the facts we have enumerated point, and with which every reasoning we have thought ourselves justified in making on them concurs, that sonorous bodies communicate their vibrations to the adjoining medium, and that these, being conveyed to the ear, occasion the sensation of sound. But here we pause, and abandon all attempts at explanation. How these things are brought to pass, we cannot say. The speculation, we conceive, is utterly fruitless, and we are little disposed to indulge in conjecture. We must confess our ignorance; for we really cannot tell, why impulse produces vibration, not colour; or what is the reason, that vibrations, communicated to the ear, are followed by the sensation of sound, and not by that of taste. We have reason to be contented with the constitution that the Creator has given us, and its adaptation to the circumstances in which we are placed. But we should think it presumptuous in this, or any other case, to say to Him, "Why hast thou made us thus?" or, "Why is the world thus formed?" though it be our employment to investigate his works, and our happiness to discover their perfection.

Practice of Acoustics.—The practice of Acoustics is plainly deducible from the ascertained laws of the vibrations of sonorous bodies, and the reflection of sound. To the former, might properly enough be referred Music, which may be considered as, in fact, a part of Acoustics. Its importance, however, and its magnitude, in conjunction with certain circumstances, dependent, apparently, on peculiar principles in the human mind, have occasioned it, and perhaps advantageously, to be always treated of in a separate treatise, to which we refer. But a few remarks fall in with the present subject. The sounds employed as the elementary parts of this delightful art, are the product of different sources, in all of which, however, vibration appears to be the proximate cause. The tension of strings, the elasticity of solid bodies, that property of the air by which it is rendered susceptible of vibrations, and the conjunction of two or all of these agents, furnish us with all the variety of notes, which, when succeeding each other, according to certain rules, constitute melody, or, when associated together, and similarly arranged, form the still more powerful and nicer branch of the musical art, denominated harmony. Tension may be held as the chief agent in many of the stringed instruments; as, the harp, guitar, violin, piano-forte, &c. Though, even in these, to a certain degree, another agent is employed, the elasticity, and perhaps the reflecting power, of what is called the sounding board. We have other examples of tension as a musical power in the case of the drum and the tambourine.

Elasticity seems the only agent in the musical tones of the bell, harmonica, gong, stacada, musical glasses, &c. We have examples of simple wind instruments, in the flute, flageolet, syrinx, &c. and of mixed ones, in the clarionet, hautbois, trumpet, bugle, &c.

The same sonorous body, as we have already remarked, may produce a variety of sounds at one time. These are generally such as might result from the vibrations of aliquot parts of the body, but they are not the same in every individual substance. In chords and open pipes, the series of parts concerned in this effect may be represented by the natural numbers; in stopped pipes, by the odd numbers only; whilst, in the case of rods and bells, it is scarcely possible to discover any determinate proportion between the fundamental and secondary or harmonic sounds, and, therefore, between the entire and the partial vibrations which occasion them. It is singular, that, in the cry of the peacock, certainly far from being a musical bird, there are two notes, one grave, the other acute, and that the latter is the octave to the former. The braying of the ass appears to be an assemblage of a great many notes, concords and discords, uttered all at once. A selection from these, or the proper management of them in series, would undoubtedly be very agreeable. The animal, however, has not the art requisite for this effect. In the feathered tribes we have many examples of great musical power, and exquisite taste. The instrument, in all of them, is to be sought for in the muscles of the larynx, made elastic seemingly by an effort of the will, and caused to vibrate by the forcible ingress and egress of the air. These muscles, according to Mr John Hunter's observation, appear to be the strongest in the best singers. The nightingale has been particularly noticed in this respect; and this accounts for the great distance at which its notes can be heard, not less, it is said, than half a mile, in a calm evening. The science of this bird has been long celebrated. Mr Barrington was able to discover sixteen different beginnings and endings, in the compass of its song; and he remarked also, that the intermediate notes were varied in their succession with so much judgment, as to give a most pleasing effect. The warbling of many birds may be said to yield harmonic sounds, which differ in different species, and appear to be dependant on some conscious exertions of the songster. The shake of some of them may be remarked not to consist of the alternation of two contiguous notes, as is usual in instrumental music, but of notes separated by a wider distance, as thirds, fifths, &c. This is done so rapidly at times, as to have nearly the effect of chords. At other times, the notes thus connected do not naturally harmonize, and the effect is consequently disagreeable. Here we speak of human auditors only, as it is probable that both the performer and his kindred are highly gratified by the exercise.

It is when the sounds combined together are related to each other, in a manner so that the vibrations admit of a common period after some alternations, that we experience a pleasing concord. Where the proportions between the associated sounds are simplest, in general we have the greatest satisfaction. And yet the ratio of equality in the frequency of vibrations, which constitutes unison, is not particularly agreeable. A little greater difference even than the proportion of two to one, or the octave, as it is called, is requisite to high musical power. Thirds and fifths, when conjoined with the fundamental tone, produce the finest harmony. But this, when long continued, or frequently recurring, becomes wearisome, and hence the necessity, as composers and performers well know, of occasionally changing both the fundamental sounds, and the proportions of the associated ones. The judicious introduction of discords, on the same principle, and as giving a peculiar expression or character to a composition, must be allowed a high place in the excellencies of the modern science.

Æolian Harp.—There is one instrument which so strikingly illustrates and exemplifies what we have now said, and which is really of so pleasing and remarkable a nature, that we must be allowed to occupy a little room in its description. The reader will perceive, we allude to the Æolian harp or lyre. This instrument has been denominated Æolian after Æolus the god of the winds in the ancient heathen mythology, from the circumstance of its being played on by the impulse of a stream or current of wind, independent altogether of any voluntary performer. It consists simply of several catgut or wire strings stretched over a sounding board, and brought into unison by an equal but slight degree of tension. In this state, when exposed to a gentle breeze of air, as at a chink of a window, it yields the richest variety of sounds, in almost every possible association and series, according to the variable force by which it is made to vibrate. Several modifications of the structure of this instrument have been proposed and carried into effect, but, in all of them, it may be remarked, the same principle, of having the strings in unison, has not been retained. Now, as it has been distinctly proved, that a single string can yield every change of harmony, according to the mode in which its various parts are affected, it is obvious that a combination of strings, brought into unison, and caused to vibrate by the ever-varying influence of a current of air, will produce an almost infinite variety of sounds. The strings, however, rarely vibrate throughout their whole length, so as to yield the fundamental notes, but most commonly are occupied with some of the harmonics. As any part of a string by the peculiar manner in which the wind blows on it, may become, as it were, a whole, and so give out a fundamental note, which again has its own harmonics, arising from the vibrations of its aliquot parts, it is evident, that a source is opened, in this very simple instrument, of almost every variety of concord, and every wildness of discord that may be requisite for the most enchanting effects. Perhaps the only thing necessary to render the Æolian harp one of the finest musical instruments, is the expression of design, or the production of air, as it is called. But of this, it is probable, from the mode in which its powers are excited, it will ever remain destitute. The only method that seems likely to redeem it from this great deficiency, is, to subject it in some suitable modification of structure, to the pipes of an organ. We hint this without having any considerable expectation that the due attention to all the circumstances of the case will ever be bestowed to render it even subsidiary to the powers of that noble engine, far less to raise it to supreme rank among manageable agents of music.

Reflection of Sound.—The reflection of sound is, apparently, obedient to the laws which regulate that of light. In both cases, the fundamental proposition holds, that the angle of reflection is equal to the angle of incidence. On this principle, then, it is easy to explain some curious and well-known phenomena.

Echo.—An echo is simply the repetition of sounds occasioned by the reflection of vibrating portions of air. The bodies producing it may be either plane or curved; and the circumstance of roughness and smoothness of surface, seems little to modify the effect. Hence, walls, rocks, the sides of hills, groves of trees, &c. are found to answer the purpose, perhaps, equally well. As sound moves very rapidly, it is evident, that the reflecting surface must be at a certain distance, in order that a portion of time may elapse between the original sound and the reflection of it to the ear of the observer that admits of being appreciated. If the distance be under 50 feet, the two sounds come so closely after each other as to be confounded together, and, therefore, it is imagined there is no echo. A distance of about 90 feet from the reflecting surface is sufficient for a single echo, that is, for one that repeats a single syllable immediately after it has been pronounced. For an echo that may repeat a dissyllable, double this distance is required, &c. Compound echoes, or those which repeat the same sound several times, are occasioned by different reflecting surfaces, situated at proper distances. We have good examples of them when cannon are fired in the neighbourhood of woods, mountains, and the sea. The sound may be distinctly observed to recur at short intervals for several seconds. It is highly probable, that the clouds are reflecting bodies. Thus, the rolling of thunder seems to be a reverberation from them, aided by some of the other bodies already mentioned on the surface of the earth; and it is quite easy to understand, how a single electrical discharge may occasion all the noise we hear in one peal. The distance at which this discharge takes place, it may be worth noticing, is pretty readily ascertained, by reckoning the time between the flash of lightning and the first of the noise. About four and a half seconds, or, which is nearly equivalent, five pulsations of the artery at the wrist of a person in good health, may be allowed for the passage of sound over the space of one mile. The same remark is, of course, applicable to the case of discharges of fire-arms, &c.

The third or fourth repetition of a sound is not necessarily weaker than the preceding ones, but, on the contrary, is sometimes louder. This has been noticed, for example, in the echo at the lakes of Killarney in Ireland. It is observable also, in certain situations, when thunder or a cannon is heard. The reason is obvious. There are more reflecting surfaces in the wider sphere, than are sufficient to compensate, by returning pulsations, for the superiority of distance gone over.

Whispering Galleries.—Sounds striking on concave surfaces are reflected from them, and after reflection converge to points which are the foci of these surfaces. It follows, therefore, that the ear may be so placed in one, as that it shall hear a sound better than when situated nearer to the point of the first impulse: again, in the case of two concave surfaces placed opposite to each other, persons in their foci may carry on a discourse which shall be inaudible to others who are intermediate. The construction of whispering galleries is founded on this principle. It has been usually found, that buildings of an elliptical or octagonal form answer best for this purpose.

Speaking Trumpet, &c.—The operation of speaking and hearing trumpets has been attempted to be explained on the principle of the reflection of sound. But there is some difficulty in the application. In general, indeed, we may remark, too much stress has been laid on the analogy between the reflection of sound and of light. On the great scale, no doubt, the resemblance is very striking; but we shall probably err, if we conclude, that the laws of light are perfectly appropriate to every minute portion of sound. Many experiments, and some very nice observations, are needed, to ascertain the peculiar differences in the two cases, or to warrant us to explain any phenomenon of the one on the known principles of the other. If analogy alone were to govern us, why, we would ask, do we give the preference to light over sound? Ought we not to give fair play to both, and so explain the phenomena of the former by what we have discovered as to the vibrations, &c. connected with the latter? The thing is absurd. Analogy, then, may mislead us.

The speaking trumpet is intended to convey the sound of the voice in a particular direction, and to a greater distance than it can reach without such aid. A hollow cone, or cylinder, of almost any kind of substance, will answer; and seems to produce the effect, principally, by preventing the diffusion of the aerial particles, till they have been subjected to a greater impulse in one direction than they would sustain if unconfined. The hands, it is well known, can be applied to the mouth so as to accomplish this purpose to a certain degree. Sailors commonly have recourse to this natural auxiliary.

The hearing trumpet somewhat corresponds in form, &c. to the speaking trumpet. It has the effect of augmenting the intensity of sound, and is therefore employed by persons who hear imperfectly. The pulsations collected by it, at the larger opening, are conceived to be directed through the tube in a condensed form, so as to come upon the ear at the smaller end with a more forcible impulse. A good deal of the effect, however, ought to be ascribed to the circumstance of the ear being secured from the distracting influence of any lateral sounds. The hand applied hollow over the ear, with an opening in front, is found to assist the hearing, probably, on both principles, but more particularly the latter.

Invisible Girl.—What are called acoustic tubes, are merely pipes, usually made of metal, employed to convey sound to a distance. They are applicable to a variety of purposes; and when combined, as they may readily be, with reflecting surfaces, are capable of producing very amusing effects: The singular deception, called the invisible girl, which was exhibited some years ago, is of this sort, and excited no small degree of interest in the attempts to explain the nature and construction of the apparatus.

A short description will easily make it understood. A large hollow metallic ball, in which are inserted four trumpets, is suspended by ribbons or slender silken cords within a frame of wood; and between this

Acoustics. frame and the ball and trumpets, all connection seems to be cut off, excepting by means of the cords or ribbons. But in two of the upper rails of the frame, there is a small opening directly opposite to two of the trumpets. These openings are covered with a fringe, or concealed by any other contrivance, to prevent them from being observed; and they communicate with a tube which passes through the two horizontal rails, is continued through one of the upright rails of the frame, and under the floor of the apartment to an adjoining room. At the termination of this tube, the accomplice, generally a lady, sits, and applying her ear to the tube, hears what is said by any person speaking near any of the trumpets; and, as the reply comes in a weak and rather indistinct voice through the tube, and is reflected from the hollow ball, it seems to proceed from the ball itself; and in this consists the deception. To see what is passing in the room, an opening is made in the partition, and filled with glass, which also is carefully concealed.

Sound-Boards.—The sound-boards sometimes used in churches, &c. in order to aid the speaker's voice, are to be considered as operating entirely by the reflection of sound which they occasion. They are not found advantageous in theatres, as their distance from the speakers is necessarily too great to admit of their being sufficiently operated on by the voice. They are generally constructed of a thin broad piece of wood. But the best shape for them does not appear to have been accurately determined. The precise purpose for which they are intended, and the nature of the building in which they are to be erected, require particular consideration. The sound post of a violin, and some other instruments, is not only useful as a prop between their two sides, or back and front, but seems to have a musical effect, both as a reflecting surface, and as being susceptible of vibrations.

Acquapendente || Acre.

ACQUAPENDENTE, a town in Italy, which is situated on a mountain, derives its name from a fall of water in its vicinity, and is 57 miles north from Rome.

ACQUARIA, a small town in the district of Modena in Italy, is 12 miles south from the city of Modena, and celebrated for its mineral waters.

ACRA, or ACARA, in *Geography*, formerly a separate kingdom on the coast of Guinea in Africa. Before the French revolutionary war, the English and other powers had strong forts and factories on this coast, with each of which was connected a separate village. These villages or towns, it is said, are all known by the name of Acra. N. Lat. 5° 40′ W. Long. 0 14′.

ACRA, one of the hills of Jerusalem, supposed to derive its name from the fortress erected upon it by Antiochus.

ACRAGAS, in *Ancient Geography*, a town of Sicily, derives its name from its situation on a steep rock. This place was called Agrigentum by the Romans; and the inhabitants are represented as having magnificent houses, and being immersed in luxury.

ACRE, the ancient Ptolemais, a sea-port town of Syria, is situated on an extensive plain, which is surrounded by a ridge of mountains on the north and east; on the south by a semicircular bay extending to mount Carmel; and on the west by the Mediterranean. Acre is celebrated, both in ancient and modern history, as the scene of many splendid warlike deeds, and, consequently, has often changed masters. Ptolemy, from whom it derived its name, surrendered it to his mother Cleopatra. The Saracens were in possession of Acre at the beginning of the 12th century, and in the holy war they were driven from it by the Christians. Saladin, the sultan of Egypt, had obtained possession of it in 1187; and in 1191, it yielded to the united arms of the Christians, after a siege of three years, and the loss of 100,000 men. In the course of the succeeding century, Acre acknowledged various sovereigns; and when the Christians were driven from Jerusalem, it became their principal town in Syria, and constituted the general emporium of trade between the eastern and western parts of the world. But, in consequence of the excessive licentiousness which prevailed in the city, plunder and robbery became common in the surrounding country. To correct these abuses, the sultan Kahlil proceeded against Acre with a great army, and, after a siege of 33 days, took the town by storm, when 60,000 Christians were either massacred or reduced to slavery.

From the time of the expulsion of the Crusaders, Acre remained in a state of desolation till it was fortified in 1750, by Daher, an Arabian Scheik, who long maintained his independence against the Ottoman government, and was at last basely put to death by its emissaries, in the 86th year of his age. In 1799, Acre again became the scene of war. The French advanced to it in the spring of that year; and as the fortifications were in a ruinous state, and mounted with a few rusty iron cannon, some of which burst every time they were fired, the pacha, Djezzar, was about to abandon the place, when Sir Sidney Smith, with a squadron, anchored in the road of Caiffa. The British admiral encouraged the pacha to hold out, and sent an engineer to assist him in fortifying the town. Acre was invested by Bonaparte himself, but all his exertions were repulsed by the activity and bravery of the British; and at the end of 61 days, having suffered many severe losses, the French raised the siege. In 1759, Acre suffered considerably from an earthquake; and in the succeeding year, 5000 persons fell victims to the plague.

Acre is one of the chief towns on this coast; the houses are built of stone, with terraced roofs; the streets are very narrow; but some of the public edifices are distinguished by their grandeur and elegance. The mosque is described as one of the finest specimens of eastern architecture; the splendid fountain is reckoned superior to the celebrated buildings of a similar description in Damascus; and the Bazar, or covered market, is spacious and elegant. The heavy rains of winter produce accumulations of water, forming lakes in the vicinity of the town; and the exhalations in summer, render the air unwholesome. The soil is fertile, and, in some places, well cultivated.

The harbour of Acre is commodious and well sheltered. The chief part of the trade consists of corn and cotton, but it is entirely monopolized by the pacha. Acre is 24 miles S. from Tyre, and 45 N. from Jerusalem. N. Lat. 32. 40. E. Long. 39. 23.

ACRE, in its original signification, from the word *acher*, Saxon, or *aker*, German, a field, was applied to any open ground of no determinate extent; but it is now used as the universal measure of land in Britain. The English acre contains four square roods of 40 perches or poles each, and each perch of 16½ feet. The English acre includes 10 square chains, of 22 yards each, or 4840 square yards. The Scotch acre contains four square roods, each rood equal to 40 falls, and each fall equal to 36 square ells. The Scots acre is also divided into 10 square chains, and the chain is 24 ells in length, divided into 100 links. The English acre is about three roods and six falls of the standard measure of Scotland. The Irish acre is equal to one acre, two roods, and about 19¼ perches English.

ACRE-*fight*, an ancient form of duel, fought by the Scotch and English, with sword and lance, on the frontiers of the kingdoms. It also obtained the name of *camp-fight;* and hence the appellation of champions, because the combatants engaged in the open field.

ACRIDOPHAGI, or LOCUST-EATERS, as the Greek words of which it is formed import, an ancient people of Ethiopia, who lived on locusts, according to the exaggerated narrative of Diodorus Siculus, a credulous historian, who lived about half a century before the Christian era. The following description of the unfortunate locust-eaters of Ethiopia, is given by that author: "Their complexion was deep black; they were of small stature, and, in general, short lived; but they were, at the same time, extremely active. They had neither herds nor flocks, but depended entirely on locusts for their food. The close of their life was most miserable. Winged insects of different kinds were ingendered in their bodies, at first about the breast, and afterwards over the whole frame; and, while the insects forced their way through the skin, an intolerable itching, which terminated in the most excruciating pains, was produced; and, at last, the miserable sufferer expired, under the most severe agony, and uttering the most dreadful cries." The same author records, that this people collected immense quantities of locusts, and having abundance of salt in the country, they preserved them for future use. The marvellous part of this relation has undoubtedly arisen from the groundless belief, that the production of insects in the body was the necessary consequence of feeding on locusts.

The term, locust-eaters, which has been a copious subject of discussion, both in ancient and modern times, ought not to be limited to any particular nation or people; for, whether from inclination or necessity, no such people could possibly exist. Those countries which are subject to the calamitous visitations of the locust, furnish also the richest crops of grain and herbage; so that the ordinary animal and vegetable food, when it can be had, must be preferred to that of any of the tribes of insects. But, if the subsistence of any nation depended solely on the locust, it would, indeed, be most precarious; since, fortunately, in regions that suffer most from the ravages of that insect, intervals of several years happen, during which not one makes its appearance. In this period, therefore, the locust-eaters, having no other resource, must perish. But the difficulty admits of an easy solution, from the consideration, that the accounts of all authentic travellers agree in stating, that locusts are eaten chiefly in times of scarcity; and, in some parts of Africa and Arabia, they are sometimes sold in the public markets. The latest account of the use of locusts as food, is given by Mr Campbell, the missionary traveller in Southern Africa; who says, that the Bosjesmen or Bushmen, are supplied in summer with locusts, which they dry and pound into powder, to be used as a substitute for flour. The term *bark-eaters* would not be less appropriate to the poor Norwegians, who, in times of famine, use the bark of certain trees, either alone or mixed with a scanty portion of grain, than that of locust-eaters to the people inhabiting those countries which are visited by that destructive insect.

The passage of Scripture which narrates, that St John the Baptist *fed on locusts*, has been a frequent subject of discussion among commentators. While some have supposed, that the word, translated *locust*, signifies the tops of certain trees, others think that it refers to quails or some other birds. But the prevailing practice in eastern countries, in times of scarcity at least, removes the difficulty, and shews that the literal import of the words may be at once admitted. And perhaps the simple fare, and humble garb, of the forerunner of Christ, were meant to be expressive of the unobtrusive character of the dispensation of the Gospel.

ACROATIC, or ACROAMATIC, denoting something profound or abstruse, is the denomination of those instructions which Aristotle delivered to the favoured or more advanced disciples; and is used in opposition to *exoteric*, which was applied to his public lectures, which, it is probable, were of a more popular character.

ACROCERAUNIA, in *Ancient Geography*, a range of mountains which divide the Ionian from the Adriatic sea, so called from being often struck with lightning, and frequently referred to by classical writers. *Monti della Chimera*, is the modern name.

ACROPOLIS, in *Ancient Geography*, the citadel of Athens, and one of the divisions of that city, as its name imports, was built on an eminence, and had nine gates or entrances, the principal of which was by a magnificent flight of steps of white marble.

ACROSPIRE, an old term in *Vegetable Physiology*, denoting the shooting or germination of grain, is chiefly applied to the process of malting, and corresponds with *radicle* and *plumula*, which are more commonly employed.

ACROSTIC, derived from two Greek words, signifying *extreme* and *verse*, is a species of poetical composition, in which the first letters of the verses form the name of the person or place intended to be commemorated. But this artificial effort of the muse is rarely recognized, even in the humbler departments of modern poetry.

ACROSTICHUM, Fork-fern, Wall-rue, or Rusty-back, a genus of plants belonging to the class Cryptogamia, and order Filices.

ACT, in the language of the English universities, denotes the thesis defended in public by candidates for degrees. For degrees in arts, it is denominated a philosophical act; for those in divinity, a theological act. At Cambridge, the appellation of *commencement* is given to the same solemnities.

ACT, in dramatic poetry, denotes the parts or divisions of a play, in which the progress of the story is interrupted for the purpose of relieving the audience and the actors. The division into regular acts formed no part of the drama of the Greeks; but the necessary pauses were filled up with choruses and similar interludes. The Romans first divided dramatic pieces into five acts, of which there are examples in the comedies of Terence, and the tragedies of Seneca; the same division has been adopted by modern writers. See POETRY.

ACT of FAITH, or *auto da fe*, in the church of Rome, denotes a solemn day, appointed by the Inquisition, for the punishment of those convicted of heresy, and the absolution of those who have been acquitted of that charge. The day fixed for this purpose usually falls on some great festival. See INQUISITION.

ACTA DIURNA, or ACTA POPULI, is the name given to a Roman news-paper, which, under the authority of government, detailed such occurrences as usually appear in similar periodical works of modern times. The following extract from Petronius, is a specimen:

" On the 26th July, a slave was put to death for uttering disrespectful words against his master.

" On the same day, a fire broke out in Pompey's gardens; it began during the night, in the steward's apartments."

ACTÆA, herb Christopher, or Baneberries, a genus of plants belonging to the Polyandria class.

ACTIAN GAMES, in *Roman Antiquity*, were instituted by Augustus, in memory of the victory obtained over Mark Antony at Actium. They were celebrated in honour of Apollo every fifth year.

ACTIAN YEARS, called also the era of Augustus, commenced at the time of the battle of Actium.

ACTION, in its general acceptation, denotes the exertion of power, and is usually employed in the same sense with *act*, although some grammarians apply the first to common or ordinary transactions, and the last only to such as are remarkable; and others suppose that the former properly belongs to the power that acts, while the latter has a reference to the effect produced.

ACTION, in *Law*, is a suit or process in a court of justice, and is employed in the same sense as it was by the Romans, from whom the phrase is derived.

ACTION, in *Mechanics*, denotes either the exertion which one body or power produces upon another, or the effect which is the result of that exertion. See MECHANICS.

ACTION, in *Oratory*, is the accommodation of the countenance, voice, and attitudes of the body of a public speaker, to the emotions of the mind, or to the subject on which he addresses an audience. See ORATORY.

ACTOR, in the drama, is one who represents some part or character on the stage. Among the Greeks, with whom dramatic exhibitions originated, a simple chorus only, who sung hymns in honour of Bacchus, constituted the whole entertainments. A declaimer, who recited the adventures of heroes, was introduced by Thespis, for the sake of variety. Æschylus changed the declamation into the form of dialogue between two persons, and Sophocles added a third, that the performance might assume a more natural aspect. To this number, the actors in the Greek drama were limited; and the Romans adopted the same rule in tragedy. In comedy, the number of actors was not restricted. In modern times, the number is regulated by the nature and incidents of the piece to be performed.

Among the Greeks, actors were greatly respected and highly honoured. The Roman actors were degraded from their rank as citizens, and, in a great measure, excluded from society; and it is curious to observe, that a similar diversity of public opinion prevails in modern times. In Britain, the degree of respectability attached to the profession of an actor, depends on his moral character; but in France, actors are despised, as they were formerly at Rome.

ACTRESS, a woman who performs a character on the stage. Actresses were not known among the ancients; for female characters were performed by men, who wore masks for the purpose.

It is supposed that female actors first appeared on the English stage in the time of James I.; for it is recorded, that his queen performed a part in a pastoral; but professional actresses were probably first iutroduced during the licentious reign of Charles II. At that period, female performers were regarded as persons of infamous character; but, in the present day, the same remark is here equally applicable as to actors; for the degree of respect in which they are held corresponds with the propriety of their moral conduct,

ACTS OF THE APOSTLES, the name of one of the books of the New Testament, which contains the history of the Church during the first 30 years after the ascension of Christ, to the year 63. It was written by St Luke, and dedicated to Theophilus; to whom also he addressed his gospel. It contains the accomplishment of several promises made by Christ to his followers, and a beautiful representation of the manners of the primitive Christians; it is written in purer Greek than some of the other books of the New Testament: it was allowed to be canonical by the council of Laodicea; and, in all subsequent ages, this has been universally admitted. See SCRIPTURES.

ACUNA, CHRISTOPHER D', a Spanish Jesuit, born at Burgos, and, while in his 15th year, admitted into the society; in 1612, was employed as a missionary in South America; and, under the aus-

Acupuncture || Adam.

pices of the Spanish government, explored the great river Amazons, from its source to its junction with the Atlantic ocean. Soon after his return to Spain in 1640, he published an account of the discoveries of his voyage on this magnificent stream. This voyage occupied ten months, from the time he left Quito till he reached Para, at the mouth of the river. This book was suppressed by the Spanish government, to prevent, it is supposed, the Portuguese, who had become masters of the Brazils, and the regions contiguous to the river Amazons, from deriving any advantage from the information which it contained. A French translation was afterwards published.

ACUPUNCTURE, which signifies pricking with a needle, is a surgical operation, not unusual in Japan, China, and some other eastern countries. It is performed by pricking the parts affected with a silver needle. This operation is employed in head-ach, lethargy, and many other diseases, and seems to be analogous to the operation of scarifying and cupping in European countries.

ADAGIO, in *Music*, is a term which signifies, that the passage thus marked should be performed in slow time; when the word is repeated, the movement is to be slower; when it is used as a substantive, as, "to play an adagio," it is expressive of a slow movement.

ADAM, the first man of the human race, was formed by God on the sixth day of the creation. The etymology of the name has often exercised the ingenuity of the learned; and it has been variously traced to words in the eastern languages which signify *red earth*, *to resemble*, *to be beautiful*, and *to be first*. Adam was made of the dust of the earth, and God *breathed into his nostrils the breath of life*. The garden of Eden, or paradise, in which grew every thing that could delight the eye, or was necessary for subsistence, was prepared for his reception. In this garden all the inferior animals which had been created were assembled. God gave Adam dominion over them, and made them pass before him, to receive names according to their nature and kinds. But Adam was still without a companion: to supply this defect, God cast him into a deep sleep, took a rib from his side, and out of it formed a woman. When Adam awoke, and the woman was presented to him, he knew her to be bone of his bone, and flesh of his flesh; on which account she was called *woman*, expressive of being taken from man. Our first parents being created in the image, and after the likeness of God, were originally in a state of innocence and purity. Placed in the garden of Eden, under the divine favour, they were permitted to enjoy all the fruits which it yielded, excepting the fruit of the "*tree of the knowledge of good and evil*," which they were commanded not to touch, under the sanction of being subjected to toil and pain, and death itself. The woman, deceived by the persuasive insinuations of the tempter under the form of a serpent, seduced her husband; and by eating the forbidden fruit, they were both guilty of transgressing the divine command. They had now lost their innocence; their eyes were opened; they were ashamed of their nakedness; and, overwhelmed with conscious guilt, they attempted to withdraw from the presence of God, and vainly sought to conceal themselves from the all-seeing eye of the Almighty. The threatened punishment was pronounced. The man was doomed to toil and sorrow; the woman, to subjection to her husband, and to suffer the pains of child-bearing; and both became liable to death. God prepared for them the skins of beasts as a covering, drove them from paradise, and, on the east side, placed "*cherubims and a flaming sword, which turned every way to keep the way to the tree of life*." Adam now called his wife *Eve*, which signifies *life*, because she was to be the mother of all mankind. The offspring of Adam mentioned in Scripture consisted of three sons, Cain, Abel, and Seth, the latter of whom was born to him while he was in his 800th year. Adam died at the age of 930 years.

Adam.

The traditionary history of Adam, as it is preserved in different countries, abounds with fable and extravagance. While some ascribe to him incomparable beauty, others suppose that he was of the most gigantic stature; and on the summit of Adam's Peak, the loftiest mountain of Ceylon, the mark of a foot of extraordinary magnitude, which is said to be that of Adam, is shewn to this day; and this mountain is noted, in the traditions of the inhabitants, as the residence of our first parents. Of the knowledge of Adam, it is asserted that he was profoundly skilled in all sciences and arts; that it exceeded the knowledge of Moses, Solomon, and even excelled that of the angels themselves. Concerning the burial-place of the progenitor of the human race, great diversity of opinion prevails. Noah, according to some, placed the body of Adam in the ark, and his grandson, Melchisedech, deposited it in the earth on mount Calvary at Jerusalem; others think that it was interred in the cave of Machpelah; and the Arabians assert that he was buried near Mecca.

ADAM, Robert, an eminent architect, was the second son of William Adam of Maryburgh in Fife, and was born at Edinburgh in 1728. Mr Adam, the father, has left some respectable specimens of his genius as an architect, in Hopetoun-house, and the Royal Infirmary at Edinburgh, which were erected from his designs. To this fortunate circumstance, perhaps, young Adam was indebted for the first bias to those studies in which he afterwards obtained such high celebrity. During the time of his education at the university of Edinburgh, he had an opportunity of associating with some of the most distinguished literary characters of the age. Having directed his thoughts to the study of architecture as a profession, Mr Adam visited the Continent in 1754, for the purpose of extending his knowledge and improving his taste; and he resided three years in Italy, where he surveyed and studied the magnificent specimens of architecture which are still exhibited even in the ruins of the public edifices of ancient Rome. In tracing the progress of architecture, and the kindred arts among the Romans, Mr Adam perceived that they had suffered a visible decline previously to the time of Dioclesian; but in contemplating the design and construction of the public baths at Rome, which were erected by that emperor, he was convinced that his munificence and

Adam.

liberal encouragement and patronage of the fine arts had revived a better taste for architecture, and had produced artists who were capable of imitating a purer and more elegant style; and while he admired the magnificent structures which afforded such ample proofs of the extent and fertility of genius of the artists from whose designs they had been executed, he was anxious to see and study whatever remains might yet exist of those masters whose works present the most striking monuments of an elegant and improved taste. With this view he undertook a voyage to Spalatro in Dalmatia, to examine the private palace of Dioclesian, to which that emperor retired, when he resigned the government, in the year 305, and which was his residence for nine years previously to his death. Accompanied by Clerisseau, a French artist, and two experienced draftsmen, Mr Adam sailed from Venice, in July 1754. On his arrival at Spalatro, he found that the palace had sustained much from the injuries of time, but it had suffered more from the dilapidations of the inhabitants, and even the foundations of the ancient edifice were covered with modern buildings. The jealous vigilance of the government soon interrupted their labours, from a suspicion that their object was to view and make plans of the fortifications; but through the friendly mediation of General Graeme, the commander of the Venetian forces, they were permitted to proceed in the undertaking; and having resumed their labours, in five weeks plans and views of the fragments were finished, from which perfect designs of the entire building were executed.

Mr Adam returned to England, and soon rose to considerable professional eminence. In 1762, he was appointed architect to the King; and in the succeeding year he published his splendid work, containing engravings and descriptions of the ruins of the palace of Spalatro. In 1768, he was chosen to represent the county of Kinross in Parliament; at the same time he resigned his office of architect to the King. In the year 1773, in conjunction with his brother James, whose eminence as an architect was also considerable, he presented to the public another splendid work, consisting of plans and elevations of public and private buildings, which were constructed from their designs. Among these are Caen-wood, the seat of Lord Mansfield; Luton-house, in Bedfordshire, belonging to Lord Bute; the new gateway of the Admiralty-office; the Register-office at Edinburgh; and many others, which have been universally admired, as excellent specimens of elegant design and pure taste. The Adelphi Buildings, in London, are also striking monuments of the fertile genius of the Messrs Adam; but so extensive an undertaking was too great for private citizens, and therefore proved an unsucessful speculation. The unlimited extent of Mr Adam's invention is not less obvious in those edifices which have been more lately erected from his designs. Those parts of the New University of Edinburgh which have been completed, bear ample testimony to this remark; and those who admire the rare union of perfect symmetry and elegant disposition of parts, united with inexpressible beauty and lightness into one whole, will find this happy combination fully exemplified in the Infirmary at Glasgow. Mr Adam's genius and refined taste for architectural design continued unimpaired to the last year of his life. In the year preceding his death, the designs of eight great public works, and of twenty-five private buildings, various in style, and beautiful in composition, were the fruit of his labours. The powers of Mr Adam's genius were not limited to the external decoration of buildings. They were exercised with similar effect in the internal arrangement and disposition of the apartments, as well as in adding variety, elegance, and beauty to the ornaments of ceilings and chimney-pieces. It will scarcely be doubted, that the improved taste which now generally prevails in the public and private edifices of this country, is in no small degree indebted to the pure and correct style introduced by Mr Adam. His talents extended beyond the line of his own profession; for, in his drawings in landscape, he exhibited a richness of composition, and an effect of light and shadow, which have been seldom equalled. Mr Adam died in March 1792, in the 64th year of his age. The elegant buildings, public and private, which have been erected in different parts of the kingdom from his designs, are lasting monuments of his genius and taste; and the natural sweetness of his manners, united to the excellence of his moral character, secured to him the affection and regard of his friends, and the esteem of all who had the happiness of enjoying his acquaintance.

Adam's-Bridge || Adams.

ADAM'S-BRIDGE, a ridge of rocks and sand-banks, which stretches from the north coast of Ceylon to the coast of Coromandel.

ADAM's-PEAK, or Hamaleel in the native language, a lofty mountain, of a conical form, in Ceylon, on which it is supposed the first man was created. This mountain is seen at the distance of 40 or 50 leagues; the summit is clothed with wood, and terminates in a plain, part of which is occupied by a lake, which is the principal source of the larger rivers of the island. It is held in great veneration in the East; is a great resort of pilgrims from all parts of India; and, for performing their devotions, chapels are erected in places which are only accessible by means of chains and ropes attached to the rocks.

ADAMANTINE SPAR, a mineral substance, which in its composition approaches nearly to that of emery, and, when reduced to powder, is applied to the same purposes of polishing hard bodies. See Mineralogy.

ADAMI POMUM, or Adam's Apple, in *Anatomy*, a protuberance in the anterior part of the throat, formed by the projection of a cartilage, and whimsically supposed to have been produced by part of the forbidden fruit sticking in Adam's throat.

ADAMS, in *Geography*, a township in the state of Massachussets, 140 miles N. W. from Boston, in North America, which is remarkable for a romantic natural bridge over Hudson's Brook, in the northern part of the district. This stream has excavated a channel for itself in a bed of white marble; and the projecting rocks form a bridge of fifteen feet in length, ten in breadth, and sixty feet above the surface of the water.

Adamson. ADAMSON, Patrick, a learned Scottish divine and poet, whose history exhibits a striking instance of the vicissitudes of life, of elevation to the highest dignity in the church, and of depression to a state of poverty and want, was born in 1536, in Perth, where he finished the early part of his education, and afterwards studied philosophy at the university of St Andrew's. In 1566, while he resided at Paris in the capacity of tutor to the son of a Scotch gentleman, the muse of Adamson celebrated the birth of James VI. in a Latin poem, in which the infant prince was panegyrised as king of France and England. The assumption of this title, even in the language of poetry, gave offence to the French court. He was arrested, thrown into prison, and detained six months in confinement. Through the intercession of the Scottish Queen he obtained his liberation, and retired to Bourges, where he lay concealed during the dreadful massacre of St Bartholomew, when the demon of persecution raged with the most relentless fury in France. Immured, as he himself expresses it, for seven months in a sepulchre, his mind was actively occupied; for, during this period, he composed a Latin tragedy, and a poetical paraphrase on the Book of Job in the same language. He returned to Scotland in 1573; and being admitted to holy orders, he was appointed minister of Paisley.

The struggle between the partizans of Presbyterian and Episcopal church government, which long agitated Scotland, and finally burst forth into the flames of civil war, had now commenced; and Adamson, whether from ambition or versatility of opinion, had his full share of the miseries which were thus entailed on the kingdom. In the General Assembly which met in 1575, he took an active part in the deliberations concerning ecclesiastical jurisdiction; and he was one of the commissioners chosen to report its proceedings to the Earl of Morton, regent of Scotland. About this time he was appointed chaplain to the regent; and soon after, when the see of St Andrew's became vacant, he was elevated to the archiepiscopal dignity. This high promotion seemed to increase the rancour and violence of the Presbyterian party, to which he was now opposed. Various charges were brought against him, as being the adviser of the oppressive and tyrannical measures which were adopted towards those who maintained that form of church government; and although he came under a humble submission to the General Assembly, the persecuting spirit of his enemies was not abated. Even circumstances in themselves of trivial import, and which would have attracted no notice in a more discerning age, were magnified into serious offences. A poor old woman, who had recommended a remedy which proved beneficial in a severe disorder under which the archbishop laboured, was charged with witchcraft, and thrown into prison; and having found means to escape, she was, at the end of four years, again apprehended under the same charge, condemned, and brought to the stake.

In 1583, during a visit of King James to St Andrew's, the archbishop distinguished himself greatly by preaching before the learned monarch, as well as by his success in a public disputation in the royal presence. Having become a favourite with James, he was appointed embassador to the English court; and both in his diplomatic and clerical character, he seems to have laboured assiduously in promoting the interest of his master in his expected succession to the crown of England. His sermons, which were remarkable for eloquence, attracted great crowds to the places where he preached; and according to the usual practice of the times, mixing the praises of his prince with religious instruction, he succeeded in impressing the minds of the English with such favourable sentiments of the Scottish King, that the jealousy of the prudent Elizabeth was awakened, and he was prohibited from entering a pulpit during his residence in her dominions.

The return of the primate to Scotland was followed by a short repose. In a provincial synod which assembled at St Andrew's in 1586, he was charged with exercising episcopal functions, in opposition to former decrees of the church; and sentence of excommunication was pronounced against him. An appeal to the King and States failed in obtaining any mitigation of his sentence; and the clamours and irritation of the populace became so violent, that he was not secure from personal injury. In consequence of a submissive apology presented to next General Assembly, he was absolved from the excommunication; but two years only elapsed when he was again harassed with prosecutions. He had fallen under the displeasure of the King; a fresh appeal, in Latin verse, accompanied with poetical paraphrases of the Books of Jeremiah and Revelations, which promised to be the most successful way of moving the compassion of that pedantic monarch, had no effect; and the archbishop, being now deprived of the revenues of his see, was reduced to such poverty, that he was actually supported by the charitable contributions of his friends till his death in 1592.

The character of this prelate, as it is drawn by the hand of a friend and an enemy, presents very different features. While in the sunshine of royal favour, it seems probable that he did not at least discourage the tyrannical measures of an arbitrary government. He was deficient in that vigour and decision of mind which are always the surest foundation of consistency of conduct, but especially in the turbulent times in which he lived. His learning was respectable; he was an eloquent and popular preacher; and his versions of different books of Scripture afford ample proofs of his facility in the composition of Latin poetry. Mr Wilson, an advocate, who was his son-in-law, and the editor of his *Poemata Sacra*, or Sacred Poetry, has pronounced an extravagant panegyric on the archbishop. "He was," says he, "a miracle of nature, and rather seemed to be the immediate production of God Almighty, than born of a woman."

Adana. ADANA, a town of Natolia in Asia Minor, which is adorned with a fine bridge and splendid fountains, and enjoys an agreeable and healthy climate. The surrounding country is rich and fertile, producing corn, fruits, and wine in abundance. Adana is 30 miles N. E. from Tarsus.

ADANSONIA, Ethiopian sour-gourd, or African cabbage-tree, a genus of plants belonging to the Monadelphia class.

ADAR, the name of one of the Hebrew months, corresponding with the end of February and beginning of March, the 6th month of their civil, and the 12th of the sacred year. A 13th month, called second *Adar*, is added every third year, to make up the annual deficiency of eleven days in the lunar year.

ADDER, or VIPER. See COLUBER, OPHIOLOGY, *Index*.

ADDER, *Sea*, a species of fishes under the genus Syngnathus. See ICHTHYOLOGY, *Index*.

ADDISON, JOSEPH, one of the ornaments of English literature, was the eldest son of Launcelot Addison, dean of Litchfield, and author of several respectable publications. He was born at Milston in Wiltshire, on the 1st of May 1672. At the Charter-house he formed an acquaintance with Sir Richard Steele, which continued through life, and produced one of the characteristic features of his literary history. In the year 1687, he entered Queen's College, Oxford, being only fifteen years of age, but quite competent, by his attainments and industrious habits, to avail himself of whatever advantage an university presented to his ambition. Here he wrote some Latin verses on the inauguration of King William, which procured him the patronage of Dr Lancaster, then one of the fellows, and afterwards provost of this college. By his interest, Addison was elected into Magdalen College, where he obtained, in 1693, the degree of Master of Arts. He continued to cultivate Latin poetry with assiduous partiality, to the improvement, no doubt, of his classical taste, but little conducive to originality of sentiment or boldness of fancy; qualities in which his muse remained defective to the end of his poetical career. There are few men who have not rather encumbered natural perfections, by assuming the garb of antiquity, than enhanced their superiority by the acquisition. Addison is not an exception. Even the mightier genius of Milton struggles with a foreign attire; and so, probably, would Homer or Virgil, had they affected the appearance of a generation a thousand years older than their own.

In his twenty-second year, Addison ventured to publish some English verses addressed to Mr Dryden, whose approbation was, perhaps, more the effusion of complacency, than the result of just criticism. In a translation of the 4th Book of the Georgics, printed in that poet's Virgil, Addison was more successful. An "Essay on the Georgics," that accompanies it, exhibited him to some advantage as a prose writer; a character on which alone his reputation with posterity is founded. The "Account of the greatest English Poets," soon followed. This poem has some happy lines, but does not indicate great depth of judgment: The extraordinary omission of Shakespeare and Otway in the list, is still less pardonable. Till lately it had been believed, that the person to whom Addison inscribed this work, indicated by the initials H. S. was Dr Henry Sacheverel, of political notoriety. This, however, is a mistake. The friend was, indeed, a Henry Sacheverel, but one far less known to fame.

Addison's poetry was not at war with prudence. He shewed sagacity in using it towards the promotion of his interest. His inspiration, therefore, is somewhat problematical, since worldly wisdom is not held a companion of the muses. Lord-keeper Somers, and Montague, afterwards Earl of Halifax, shared in its eulogiums, and befriended the author. The former procured him a pension of L.300, which enabled him to undertake a visit to the continent. Previously, however, he had relinquished the intention of entering the church, in which his advancement might have been confidently expected. On his travels he wrote his famous epistle to Halifax, and commenced his still more famous tragedy of Cato. It was in Italy that the spirit of Addison was tuned to the praise of liberty, so congenial to the constitution of his countrymen, at that time boasting the recovery, or at least the possession of a free government. Well might he say,

> Thee, Goddess, thee, Britannia's isle adores;
> How has she oft exhausted all her stores,
> How oft in fields of death thy presence sought,
> Nor thinks the mighty prize too dearly bought!

But it is one of the consequences of the blessing, that certain perpetuity is denied to the possessors of official dignity. This Addison found to his cost before he returned home. His friends, on the death of King William, were removed from power; Halifax was impeached by the Commons, and his own pension was discontinued. This was the only time of his life in which he experienced an approach to poverty. The grievance taught him to set a higher value on money than, it has been idly imagined, is consistent with greatness of character. They who object to the estimate, are not aware of the misery from which pecuniary means have the power to redeem; or that the magnanimity which is in alliance with rags and hunger, would have but a sorry chance for their admiration.

A ray of hope unexpectedly beamed upon Addison in 1704, and pointed the road to affluence. Godolphin, the Lord-treasurer, at the instigation of Lord Halifax, employed him to celebrate the battle of Blenheim. The immediate reward of his poem, *The Campaign*, was the appointment of a commissioner of appeals, in which he succeeded the illustrious John Locke. Other advantages followed in train. In 1706, he was chosen Under-secretary of State to Sir Charles Hedges; was retained in this office by the Earl of Sunderland; went over to Ireland in 1709, as secretary to the Marquis of Wharton; and obtained from the Queen the place of keeper of the records in that kingdom, with an augmentation of the salary annexed to it. For this last favour he was indebted to the recommendation of the Duchess of Marlborough, to whom he had prudentially enough, but with little consideration of taste, inscribed his poem of Rosamond.

Addison's attachment to Whig principles did not prevent an honourable friendship between him and Swift, so violent for Toryism. These men could esteem each other through the medium of their political dissentions, though, at last, their increasing zeal precluded intimacy. Some of their correspondence is preserved, and is mutually kind and respectful. Pope, somewhat younger than Addison, was not quite so indulgent, and on the whole, perhaps, had less reason. The connection with Steele was of most consequence to literature.

This gentleman commenced the Tatler during Addison's residence in Ireland. The publication, which originated without his knowledge, having, however, indicated its author, by the insertion of a criticism with which Steele had been entrusted, acquired his powerful and continued aid. To this succeeded the Spectator, which commenced on the 1st of March 1711. Addison's papers in the Spectator are marked by one of the letters in the word *Clio*, and in the Guardian, another periodical work in which he was afterwards engaged, by a hand; his papers in the Tatler have no such distinctions.

The success of Cato, which appeared in 1713, exceeded the author's hopes; Whigs and Tories uniting to applaud it,—the former, because it yielded fuel to the flame of liberty; the latter, because they *would not* be mortified by the high-toned triumphs of their opponents. Fashion and habit now enjoin its commendation, as an evidence of good taste, though the morality of the Christian religion condemn the pride of its hero, and criticism object the poverty of its subordinate characters, and the unsubdued dulness of its story. Lofty sentiments, couched in glowing language, impose on minds aspiring after the *sublime* of life; but reason, if unbiassed by excellencies in the representative republican, abates the credit of the delusion. In our sober moments, we cannot behold a man " lord it so," over the best and most amiable feelings of our nature, without entertaining a degree of indignation at his cold blooded arrogance, and something like contempt of those who can so far estrange themselves from common sense and humanity, as to hail such conduct " godlike."

About the same period, Addison, thoroughly wedded to his political creed, and suffering for it in the loss of his places, produced the *Whig Examiner*, and some pamphlets, in defence of his party. The *Freeholder*, also a political paper, appeared somewhat later. These have lost their interest in the lapse of years, but the purity of style, conciseness of thought, and felicity of allusion which characterise Addison, are no where in his writings more discernible.

On the accession of George I., his political labours were rewarded by the office of secretary to the Earl of Sunderland, Lord-lieutenant of Ireland. This he soon gave up to become a Lord of Trade; and, in 1717, he reached his highest elevation as one of the principal Secretaries of State, an honour, however, which his ill health did not permit him long to enjoy. He resigned it on a pension of L.1500, intending to occupy the remainder of his time in literary pursuits which might conduce to human happiness and improvement.

The chief production of his retirement was an essay on the " Evidences of the Christian Religion," in which he avowed his stedfast belief. He died on the 17th of June 1719, when entering on his 54th year, and left an only daughter by the Countess of Warwick, whom he married in 1716. Uncontradicted report has assigned much unhappiness to this union, occasioned by the lady's conceit of her superior rank, which even the singular worth of her husband could not restrain into decency. Yet whether, in common style, from a wish to make things look better than they were, out of real affection, or the distinguishing benevolence of a dying man, Addison mentions her in his will with the greatest tenderness and respect. An incident in his departing struggle, has always been noticed with admiration. Finding his end near, he sent for Lord Warwick, his wife's son, by a former marriage " a youth," as Dr Young modestly expresses it, " finely accomplished, but not above being the better for good impressions from a dying friend." The interview was short. After a pause, the young man said, " Dear Sir! you sent for me, I believe: I hope that you have some commands; I shall hold them most sacred." To which Addison replied in a soft voice, whilst he grasped his hand, " SEE IN WHAT PEACE A CHRISTIAN CAN DIE," and soon expired.

Addison's talents were not ready; they sought time, and retirement, and indulgence. He was unfit, therefore, for the public duties of his ministerial situation, or, at least required unusual conditions for their fulfilment. But we must not ascribe the deficiency to a distrust in his own abilities; this is a common mistake. As to Addison, it is irreconcileable with the fastidiousness of his taste, which was undoubtedly subservient to the preservation of the consequence he had already acquired; and it is alike disproved by the unaccommodating tone of his political publications, and the easy gaiety with which he could converse where his influence was allowed to be supreme.

His writings, which seem a fair reflection of his character, claim respect rather than elicit admiration; they scarcely ever need indulgence. Their morality is polite, not authoritative. They recommend the kindly affections and the graces which every one applauds; and they dissuade from vices and rudenesses which every one condemns. Addison and his reader, accordingly, are always on good terms. Even his religion is agreeable—to the profligate, because it discloses some excellencies in their heart, which need but a little encouragement to retrieve and surpass their transgressions—to the pure in their own eyes, and wise in their own conceit, because it is readily available to a dear delusion, and inculcates no self-denial—to all, because its simplicity solicits the meanest understanding, its specious importance employs the highest, whilst it garnishes the path of duty with so many fruits and flowers that neither fancy nor the heart desires to wander.

His style abounds in beauties, which, though not superlative, never fail to attract. It is easy, perspicuous, concise, elegant,—free from the blemishes of his time, indecency, antithesis, and conceit,—but free also from the wild and loftier excellencies which marked an earlier period of our literature; it wants soul, and it wants passion,—it has mind, indeed, always, and sometimes feeling, but the former is unruffled to wearisomeness, like the sea in a calm, and the latter is so nicely adjusted by rule and compass, that we never have a moment's interest or apprehension about its issue. Addison frequents the court, the drawing-room, the tavern,—is familiar with all, paints all so faithfully, so naturally, so humorously, that we seem to be one in every party as much as himself, and to have a common right to judge, admire, dislike, laugh, in short to retain all the incontestible privileges of our own fire-side. But he rarely quits the city, and when he does, it is but to visit the garden or the meadow, where every thing is regular, nicely trimmed, and well fenced, and constantly reminds us of the encroachments which industry and skill have made on the dominions of nature. Of wildernesses, forests, cataracts, the Alps, or the Andes, he has no knowledge; storms, whirlwinds, and earthquakes, never disturb his creation: even his visions and dreams have the method and monotony of civilization; his calamities and prosperities, his misfortunes and rejoicings, like the items in a merchant's book, are all appreciated in the pounds, shillings, and pence of Old England. On the whole, he is a writer of good sense and good manners; he instructs a little, amuses more,—he may be said to have refined our language at the expence of its strength, to have given it clearness, but to have deprived it of its elasticity and power,—he inculcates by example, perhaps the best mode for general adoption, a hesitating and cautious reserve in composition, which *may* escape blunders and absurdities, but which *must* repress vigorous conception, and stifle heart-born eloquence.

ADDITION, in *Arithmetic* and *Algebra*, is the rule by which two or more numbers or quantities are brought into one. See MATHEMATICS.

ADEL, a kingdom of Africa lying on the eastern coast of that continent, bounded by the Indian Ocean on the east, by Abyssinia on the west, and extending about 500 miles from east to west, and about 300 miles from north to south. This kingdom was formerly tributary to the sovereigns of Abyssinia; but an Abyssinian prince having escaped from the confinement to which the branches of the royal family excluded from power are doomed, found an asylum in Adel, married the daughter of the king, and erected it into an independent state. Since the beginning of the 16th century, the open warfare which then commenced has been seldom interrupted. Religious enmity has probably had no small share in continuing the struggle for conquest and power; for the Abyssinians are Christians, and the people of Adel profess the Mahometan faith, and acknowledge the sovereignty of the Grand Signior.

The temperature of the air is very considerable; rain seldom falls; and the climate is in general unwholesome. The interior districts of the kingdom are unknown to strangers: in some places, nothing is seen but extensive barren desarts; others are covered with rich soil, which produces abundance of corn, and feeds numerous herds of cattle, and, particularly, that singular variety of sheep with broad tails, some of which exceed twenty pounds weight. Some of the inhabitants are of a black, and others of a tawny complexion. Adel and Zeila are the chief towns, from which, and others on the coast, there is a considerable trade in ivory, gold dust, and valuable drugs, which are exchanged for the rich productions of Arabia and other eastern regions. Adel, the capital, which gives name to the kingdom, is in N. Lat. 8° 5. and E. Long. 44. 20. and 300 miles south from Mocha.

ADEN, is the chief town of a country of the same name near the southern extremity of Arabia Felix, and to the eastward of the straits of Babelmandel. The town is nearly encompassed with lofty mountains, from which it derives an ample supply of water by means of a splendid aqueduct. Aden successfully resisted an attack of the Portuguese in 1513; but soon after fell under the dominion of the Turks, who were dispossessed by the king of Yemen, by whom its trade was transferred to Mocha. Before this period, Aden, from its local position, had become a celebrated emporium. N. Lat. 12. 40. E. Long. 46. 13.

ADENANTHERA, Bastard Flower-fence, a genus of plants belonging to the Decandria class.

ADERBIJAN, a province of Persia, part of which is bounded on the east by the Caspian Sea. Tauris, or Tebriz, formerly the residence of the Persian monarchs, is the principal town, the trade and population of which are considerable.

ADHA, a solemn festival celebrated by the Mahometans on the tenth day of the last month of their year, on which a sheep is offered in sacrifice at Mecca, but no where else. This festival is denominated the *Great Bairam*; and, from the numerous ceremonies observed by the pilgrims in this month, it is called the *month of pilgrimage*.

ADHERENCE, action of, in the *Law of Scotland*, an action which is commenced at the instance of a husband or wife, to compel either party to return or adhere in case of desertion.

ADHESION, signifies the sticking or adhering of two bodies which are naturally separate; but is often employed to denote the force of attraction between the surfaces of two solid bodies, as the polished surfaces of glass, marble, or metal; or between a solid and a liquid, as glass and quicksilver. See AFFINITY, under CHEMISTRY.

ADIANTUM, Maidenhair, a genus of plants belonging to the Cryptogamia class.

ADJECTIVE, a word joined with a noun, and expressive of some accident, property, or quality existing in any thing, as, a *good man*, in which the adjective *good* denotes the quality of goodness in the man to whom it is applied. See GRAMMAR.

ADIPOCIRE, from two Latin words, which signify *fat* and *wax*, is applied to a substance whose properties are intermediate between these two substances. Adipocire is formed by a certain change of the soft parts of animal bodies, subjected for some time to running water, or when a great quantity of animal matters is accumulated in a moist place. It was found in abundance, when the remains of the bodies were removed from the burial-ground of the *Innocens*, in Paris, in 1787, and seems to have been generated by the great mass of animal matters, twelve or fifteen hundred bodies deposited in the same pit. See CHEMISTRY, *Index*.

ADJUDICATION, is the act of adjudging or determining the right or property of a thing, by the decision of a judge, in favour of some party. In the law of Scotland, it is an action by which a creditor obtains possession of the heritable property of his debtor, or the debtor's heir; or, it is an action by which a person possessing an heritable right, may supply any defect in that right in point of form.

ADMINISTRATION denotes, in general, the government or management of affairs, and, particularly, the exercise of distributive justice. Among ecclesiastics, it is employed to express the dispensation of the sacraments. The same word is used by the Spaniards, to denote the warehouse or magazine at Callao, and other ports in South America, in which foreign ships deposit their cargoes, on the payment of certain duties.

ADMINISTRATOR, in the *Law of England*, is a person to whom is entrusted the management of the goods of another who has neglected to appoint an executor, and who possesses similar powers. In the law of Scotland, it is applied to a person who is authorised by law to direct the affairs of another, who is incapable from age or mental imbecility of acting for himself. A father, who is empowered by law to have the charge of the persons and property of his children, during their minority, is denominated their administrator.

ADMIRAL, an officer or magistrate who presides in the court appointed for the regulation and trial of all maritime affairs, and to whom is entrusted the command of the whole or part of a navy. The origin of this high office, which has existed from a very early period, in almost every maritime state, and even the etymology of the name, are undetermined. Some antiquarians trace it to the word *amir* or *emir*, which is a general appellation among the Saracens or Arabians, for a chief ruler, governor, or commander, and, in confirmation of this opinion, assert that the name and office were introduced into Europe during the Crusades. The Sicilians, it is said, were the first, and the Genoese the next, who bestowed the name of *admiral* on the commander of their fleets. It does not appear, from the researches of antiquarians, that this name was known in England before the latter end of the long reign of Henry III. The first title of Admiral of England was given in 1387, by Richard II. to the Earl of Arundel and Surrey.

To the High Admiral, or Lord High Admiral of England, the sole management and direction of maritime affairs are entrusted. He has the command of the royal navy, the appointment of admirals and all other officers, and he possesses a civil and criminal jurisdiction in all maritime matters. But the administration of this high office has been long discontinued, and is now delegated to six persons, who are denominated Lords Commissioners of the Admiralty, and who, by statute of William and Mary, have the same power and privileges as the Lord High Admiral.

A similar officer, with extensive powers, formerly existed in Scotland; but the duties of this office fell under the cognizance of the Lords of the Admiralty for Britain, and a vice-admiral is appointed by the crown, who possesses a civil and criminal jurisdiction; and the duty of the office is executed by a deputy called the Judge-admiral, in whose court all cases connected with maritime affairs are tried.

Admiral is the denomination of the highest rank of officers in the British navy. Admirals are divided into three classes, which are distinguished by the colour of their flags, red, white, and blue; and each admiral has a vice and rear-admiral subordinate to him. The admiral carries his flag at the main top-mast head; the vice-admiral at the fore top-mast head; and the rear-admiral at the mizen top-mast head.

ADMIRALTY, court of, a supreme court, held by the Lord High Admiral, or Lords of the Admiralty, for the cognizance of all maritime affairs, whether of a civil or criminal nature. All offences committed on the high-seas, or on great rivers, below the first bridge, or on the shores of all countries subject to Great Britain, are tried in this court. In England, the Lord Chancellor appoints commissioners for the trial of all criminal cases before a jury. These commissioners are the judges of the court of admiralty. From the sentence of this court, an appeal lies to the King in Chancery.

In Scotland, the supreme court of the Judge-admiral grants commissions to admirals within certain jurisdictions to hold inferior courts; and from their decisions an appeal may be made to the supreme court.

ADMIRALTY BAY, a spacious bay on the west coast of Cooke's Straights, in the southern island of New Zealand. This bay affords good anchorage, and, on many parts of the coast wood and water can be obtained in abundance. S. Lat. 40° 37′ E. Long. 174° 54′.

ADMIRALTY ISLANDS, a cluster of between 20 and 30 islands, lying in S. Lat. 2° 18′ and E. Long. 146° 44′, which were discovered by Captain Carteret, by whom they are described as exhibiting a rich verdure of lofty and luxuriant woods, interspersed with plantations, in which appear groves of cocoa-nut trees, and houses of the natives, who seem to be very numerous. The state of the ship prevented him from landing, but the climate, which seemed to be the same as that of the Moluccas, is favourable for the production of spices.

ADMIRATION is that emotion of the mind which is produced by the contemplation of superior and rare excellence, as, uncommon wisdom or ingenuity.

ADNOUN is a word synonimous with adjective, because it is added to or conjoined with a noun.

ADOLESCENCE, denotes that period of life between infancy and manhood, which is usually reckoned between 15 and 25 or 30 years of age. The period of adolescence among the Romans was reckoned from 12 to 25 in males, and from 12 to 21 in females.

ADOM, a small state or principality of the Gold Coast in Africa. The country, which is rich and populous, abounds in corn and fruits, and feeds numerous herds of cattle. Gold and silver collected in the interior, form articles of trade, and a considerable revenue was formerly derived from the negro slaves brought from the northern parts of Africa.

ADONIA, solemn feasts which were celebrated by many eastern nations, in honour of Venus, and in memory of Adonis, with whom she was deeply enamoured. Adonis was the son of Cynaras, king of Cyprus, was slain by a wild boar, and changed into a flower of a blood-red colour: but, according to another fable, he was a beautiful shepherd, and, after being killed by the boar, was converted into a river, the waters of which, during the annual inundations, were stained with a red earth which was washed from the contiguous soil, and were supposed to be tinged with blood from the wound bleeding afresh. According to one account of these festivals, they lasted two days; one of which was occupied in expressions of grief, by weeping, wailing, tearing the hair, and beating the breast; and the other was devoted to rejoicings, in which the praises of Adonis were celebrated, as if he had been restored to life. But, according to another explanation of these ceremonies, the days of mourning and joy constituted two distinct festivals, kept at different periods of the year, with an interval of six months. From this consideration, it seems probable, that the fabulous history of these festivals is connected with certain natural occurrences, as the change of seasons, or periodical inundations, which are not unusual in eastern countries. Might not this view afford some light to the researches of antiquarians in tracing their nature and origin? The Egyptians, it is said, observed festivals of a similar character, to commemorate the sickness, recovery, or death of Osiris; by some, their origin is derived from the slaughter of the first born in Egypt in the time of Moses; and the prophet Ezekiel refers to something of the same kind, when he says, chap. viii. that he saw women sitting in the temple, and weeping for Adonis.

ADONIS, Birds or Pheasant's Eye, a genus of plants belonging to the Polyandria class.

ADONISTS, a name applied to certain divines or critics, who assert, that the natural points of the word Jehovah are not usually annexed to that word, but the points belonging to Adonai; because, it is said that the Jews were prohibited from pronouncing the word Jehovah, for which Adonai was substituted and read. To the Adonists are opposed the Jehovists, who maintain a contrary opinion.

ADOPTION, the act by which a person receives another into his family, acknowledges him for his son, and admits him to all the privileges of that relation. The indulgence of the natural feeling of leaving a name and memorial, has introduced the practice of adoption into all countries; and, that it might not be indiscriminately followed, laws and certain formalities have been established for its regulation. This custom prevailed greatly among the ancient Greeks and Romans. It was requisite that the person who adopted should be without children, should be advanced in life, and, at least, 18 years older than the son to be adopted, that the new relation might appear natural.

Adoption, or *filiation*, as it was called among the Greeks, was permitted to such as had no offspring of their own, excepting those who were incapacitated from managing their own affairs, as idiots, infants, slaves, &c. When the ceremony of adoption was performed, the name of the adopted was enrolled in the tribe of his new father. To give it more solemnity, this enrolment took place on a particular festival; and, by a law of the Lacedæmonians, the ceremony was partly performed, or at least received confirmation, in presence of their kings. The adopted, possessing all the privileges of children, were bound to observe all their duties; they ceased to have any claims of inheritance on the family which they had left; and they were not permitted, by the laws of Solon, to renounce their adoption, without having offspring to remain as substitutes. A law of the Athenians prohibited the person who adopted another from marrying, without permission from the magistrate; and, in case of children by marriage, the adopted shared equally with them in the inheritance.

Two forms of adoption were observed among the Romans; the one in presence of the prætor, when the natural father resigned all authority over his son, and expressed his consent to his being adopted by another. The other mode was practised during the republic, at an assembly of the people, and afterwards by an order from the emperor; and in this case, the party adopted was already free.

Among the Mahometans, adoption forms no impediment to marriage. The ceremony of adoption among the Turks consists in drawing the adopted person through the shirt of the adopting father; and hence the phrase which expresses adoption among that people, *to draw another through my shirt*. The resemblance of this ceremony is traced to the practice of the Hebrews, as in the case of Elijah adopting Elisha for his son and successor, and communicating the gift of prophecy, by covering him with his mantle, and then by letting it fall while he was ascending in the chariot of fire. The exchange of girdles is a simple form of adoption equally valid, which in modern times is sometimes practised among the Turks, Greeks, and Armenians.

Adoption is regulated by law among the Gentoos; and the ceremony is performed in presence of the magistrate, by giving gold and rice to the father of the child to be adopted, which are the symbols of a purchase. But no person having a son or grandson, &c. or whose brother has a son, is permitted to adopt.

Adoption by arms, was when a present of arms was made by a prince to any person on account of his merit and services. The obligation laid on the adopted son, required him to defend and protect the father from all kinds of injury and insult. From this practice the ceremony of dubbing knights, according to some, derives its origin and name.

ADORATION, an act of worship, or the external expression of the sentiments of veneration and regard towards the Supreme Being; but it refers also to a similar act performed to other objects. The word is derived from two Latin words, signifying to *apply the hand to the mouth*, or *to kiss the hand*; in allusion probably to a common custom in eastern countries of kissing the hand in token of respect and submission.

In the religious worship of the ancient Romans, adoration was performed with the head covered, and the right hand applied to the mouth; by bowing the head, and turning the body from left to right. But in the adoration of Saturn and Hercules, the head was uncovered; and this was called the Greek mode of adoration. Bowing, kneeling, and prostration, were the usual modes of adoration among the Jews; and, among Christians, this act is performed with the head uncovered. The usual posture of the ancient Christians was kneeling in private, but in the public assemblies they stood. Presbyterians have generally adopted the standing posture; while the form of kneeling is observed in the Lutheran churches. In eastern countries, it is common to take off the shoes or slippers, before entering a place of worship; and the Persians, and some other nations, direct their faces towards the sun, or to the east, in the act of adoration.

Similar marks of honour and respect were paid to persons of high rank. The Roman and Grecian emperors were adored by bowing or kneeling at their feet, touching the purple robe, withdrawing the hand, and applying it to the lips. The Persian mode of adoration, which was introduced by Cyrus, consisted in bending the knee and falling on the face, striking the earth with the forehead, and kissing the ground. In the English court, the ceremony of kissing the hand of the sovereign, as an acknowledgment of honours conferred or favours received, which is performed in a kneeling posture, may be regarded as an act of adoration of a similar character.

Adoration, in the court of Rome, is the ceremony of kissing the Pope's feet, the origin of which, it is supposed, has been derived from a similar practice among the Roman emperors. That the people might be less reluctant in this mark of respect, Dioclesian, it is said, had gems attached to his shoes; and the Roman pontiffs have the figure of a crucifix on their slippers, that the adoration paid to the Pope may seem to be transferred to Christ.

ADOUR, a river of France, which rises in the mountains of Bigorre, in the upper Pyrenees, and running in a northerly direction through Gascony, turns afterwards to the east, passes by Dax, and falls into the Bay of Biscay, below Bayonne.

ADOWA, the chief town of Tigré in Abyssinia, is situated on the declivity of a hill, on the side of a plain which is surrounded by mountains. The name, which signifies *pass* or *passage*, is descriptive of its situation, for it is the only passage from the Red Sea to Gondar. Adowa is the residence of the governor, contains about 300 houses, and has a manufactory of coarse cotton cloth, which is employed as the circulating medium in Abyssinia. N. Lat. 14° 7′ E. Long. 38° 50′.

ADOXA, tuberous moschatel, or hollow-root, a genus of plants belonging to the Octandria class.

ADRASTUS, a king of Argos, is celebrated in history as one of the seven warriors who conducted their forces against Thebes, in support of Polynices, who was excluded by his brother Eteocles from his share of the sovereign authority. Adrastus, who escaped by the swiftness of his horse, was the only one who survived the expedition. After the lapse of ten years, the sons of the seven chiefs renewed the war, and became masters of Thebes. The only leader who fell, was the son of Adrastus, for whose loss he was so afflicted, that he died of grief at Megara, as he was returning with his victorious army. The first war is celebrated by Statius, in the Thebaid; and the last, called the war of the Epigones, or descendants, forms the subject of Wilkie's Epigoniad.

ADRIAN, or HADRIAN, PUBLIUS ÆLIUS, a celebrated Roman emperor, was born at Rome, in the 76th year of the Christian era. Deprived of his father in his tenth year, he was placed under the guardianship of Trajan. He soon discovered a strong predilection for literature, in the acquisition of which he was greatly distinguished, and particularly in the knowledge of the Greek language, which was now assiduously cultivated by the learned Romans. Adrian commenced his military career in early life, and served as tribune in the army, by whom he was chosen to announce the death of Nerva to Trajan, and to congratulate him on his accession to the imperial throne. Adrian, it has been asserted, on account of some peculiarity of temper or character, or from his attachment to learning, was disliked by Trajan. But this seems little consistent with his promotion to places of high trust and confidence, which he held under that emperor. In almost every expedition which Trajan undertook, Adrian accompanied him as quæstor; and he was afterwards appointed tribune of the people, prætor, governor of provinces, and pro-consul. But if Adrian really failed in securing the attachment of Trajan, he was fortunate in obtaining the favour and influence of the Empress Plotina. Through her means, his marriage with Sabina, the Emperor's grand-niece, was accomplished; an event which probably opened the path to his future greatness. On the death of Trajan, which happened when Adrian was governor of Syria, and commander of the army, the empress, in a communication to the senate, declared that her husband had adopted him as his heir. When the news reached Adrian, he caused himself to be proclaimed emperor.

Adrian was invested with the imperial dignity in the year 117. The first act of his government was the restoration of the conquered countries to the Persians; and the remission of the enormous sum of more than L.7,000,000 sterling, in debts due to the state by individuals, cities, and provinces, acquired for him a high degree of popularity, and is commemorated in medals struck on the occasion, in which he is represented with a flambeau in his hand, setting fire to the bonds which his extraordinary generosity had cancelled. On his return to Rome in 118, a triumph, and the affectionate title of *Father of his country*, were decreed to him by the senate. But he had the magnanimity to decline the proffered honours.

Two years afterwards, Adrian visited Germany, Gaul, and Britain. To give greater security to the Roman power in Britain, he contracted the limits of his dominion; and, to restrain the irregular warfare of the native Caledonians, he constructed the celebrated wall which still bears his name. This stupendous work extended from the river Tyne at Newcastle, to the Solway Frith, a distance of 60 miles; and its remains are still visible in different parts of its course, as in the vicinity of Hexham, westward from Carlisle, and near its termination at the village

Adrian.

of Bowness. Adrian, on his return to Rome, was greeted with the title of Restorer of Britain, and medals were struck in honour of this event.

From this period to his death, he was constantly occupied in visiting the widely extended provinces of the empire. The activity of his mind was not solely confined to the political affairs of his administration; for, while he was in Sicily, he ascended Ætna to contemplate the striking appearances of that celebrated volcanic mountain; and he spent a night on its summit, that he might enjoy the glowing beauties of the rising sun. During the active and vigorous reign of this wise and prudent prince, it must ever be regretted, that the Christians had been subjected to severe persecution; and the wanton indignities, and studied insults, heaped on the Jews, are altogether irreconcileable with the generous conduct of a magnanimous conqueror towards a subjugated and depressed people. The images of swine, an animal held in abhorrence by the Jewish nation, were engraven on the gates of Jerusalem; the statues of the heathen divinities were erected in the most sacred places; and they were not permitted to revisit the holy city, excepting on one day of the year, which was fixed for the anniversary of their subjection to the Roman power.

Adrian was seized with a dropsical disorder which terminated his existence in the 63d year of his age, and the 22d of his reign. His character exhibits a singular assemblage of virtue and vice. He was generous, affable, and courteous; but, in his natural disposition, he was suspicious, envious, and cruel; capricious in his attachment, and violent in his resentment; distrusted by his friends, and dreaded by his enemies. Adrian is represented as an excellent scholar, and as a liberal patron of learning. Fragments of his Latin poetry are still extant; and a Greek poem, entitled *Alexandriad*, of which favourable specimens have been quoted by the ancients, was the production of his muse. A prose work, the history of his own life, to which the name of his freed man Phlegon is prefixed, has been ascribed to Adrian. But the following verses addressed to his soul, composed, it is said, on his deathbed, and in a strain of tender levity, have been often read and admired, and have been the subject of numerous translations and imitations by modern poets:

Animula, vagula, blandula,
Hospes, comesque, corporis,
Quæ nunc abibis in loca
Pallidula, rigida, nudula,
Nex, ut soles, dabis jocos?

Ah! fleeting spirit! wandering fire,
That long hast warmed my tender breast,
Must thou no more this frame inspire,
No more a pleasing cheerful guest?
Whither, ah whither, art thou flying?
To what dark undiscovered shore?
Thou seem'st all trembling, shivering, dying,
And wit and humour are no more?—Pope.

Adrian IV. Pope, the only Englishman who enjoyed the papal dignity, and whose original name was Nicolas Brekespere, was born at Langley, near St Albans, in Hertfordshire. His father had assumed the monastic habit in the monastery of St Albans; but his own application, whether he was urged to it by the pressure of poverty, or by motives of piety, to be admitted into the same religious establishment, was rejected. Driven from his native country by this disappointment, he fixed his residence in Paris, where he soon attained, by his assiduity and industry, considerable distinction for theological learning. Still inclined to a monastic life, he retired to Provence, became a regular clerk in the monastery of St Rufus, was afterwards promoted to the canonical order, and, by his learning, prudence, and rigid observance of the rules of the institution, was, on the death of the abbot in 1137, elected superior of the establishment. The monks beheld the elevation of a foreigner with a jealous eye, and were little disposed to submit quietly to his authority; and the Pope, anxious to secure the tranquillity of the monastery, saw that it was necessary to remove him: but holding his talents and merit in high estimation, he immediately conferred upon him the dignity of Cardinal Bishop of Alba, and afterwards the appointment of legate to Denmark and Norway, where he succeeded in converting the natives to the Catholic faith, and established the archiepiscopal see of Upsal. Soon after his return to Rome, Pope Anastasius died, and he was unanimously chosen to be his successor in the papal chair, when he assumed the name of Adrian.

Henry the Second of England, gratified to see an Englishman promoted to the holy see, appointed a splendid embassy, composed of the abbot of St Albans and three bishops, to offer sentiments of congratulation, along with many rich presents. The presents were declined; but the abbot obtained for his monastery some valuable privileges; and, in particular, an entire exemption from all episcopal jurisdiction, except to that of the see of Rome. Adrian's elevation to the papal throne brought with it much anxiety and disquietude. Political discussions with the Roman magistrates, produced an interdict from religious worship for several months, which was removed by the banishment of Arnold of Brescia, a popular leader, who was afterwards recalled, and condemned for his sedition or heresy to be burned alive. The sentence was executed, and his ashes were thrown into the Tyber, that his followers might be precluded from seizing and preserving them as precious relics. Adrian was involved in constant struggles with kings and princes, one of whom, the king of the Romans, performed the humiliating penance of holding his stirrup while he mounted his horse; and another, the king of Sicily, was excommunicated for encroaching on the territory of the church. The troubles of a short reign of four years and nine months, which terminated in 1159, although not unmarked by vigour, prudence, and dignity, drew from the dying pontiff a sentiment similar to that which is expressed by the bard of Avon;

"Uneasy lies the head that wears a crown."
Shakespeare.

Adrianople.

ADRIANOPLE, a city in the province of Romania, in the European part of the Turkish dominions, derives its name from the Roman emperor Adrian, by whom it was built or improved, stands in a plain on the banks of the river Mariza, and is encompassed by mountains. It is six or seven miles in circumference, and is surrounded by a wall. Many of the houses are low and built of mud; some are constructed of brick, in a better style. The streets are irregular, narrow, and dirty. The number of inhabitants of all nations exceeds 100,000. It contains three bazars or market-places; one of which is an arched building, half a mile in length, and divided into 365 splendid shops; a second, a mile in length, is also well provided with shops of an inferior description; and the third, in a different quarter of the city, is covered with boards, supported by a double row of massy columns, and is appropriated to the sale of works in gold and silver, jewels, and warlike instruments. The palace of the grand vizier, in the Turkish style, is remarkable for its extent and the beauty of its situation. But the chief ornaments of Adrianople are four mosques, of elegant construction and unrivalled execution, whose lofty spires, galleries resting on beautifully sculptured columns, with pedestals and other embellishments of cast brass; cupolas surmounted with gilded balls; gates of the finest marble, most exquisitely carved; magnificent porticos, and splendid fountains, present altogether one of the most impressive scenes of eastern grandeur. The Greek emperor was dispossessed of Adrianople in 1362, by the Turks, and it continued to be their metropolis till Constantinople, in 1452, yielded to the arms of Mahomet II. It is now governed by a Mullah cadi with absolute authority, is the seat of a Greek bishop, and, in times of commotion, is the residence of the Grand Signior. N. Lat. 41. 41. E. Long. 26. 27.

ADRIATIC SEA, or Gulf of Venice, an arm of the Mediterranean, which is bounded on the east by Dalmatia, Sclavonia, and Turkey, and on the west by Italy, extends from south-east to north-west about 200 leagues, and is about 50 in breadth. The temperature of the Adriatic is considerable in summer; but in the vicinity of Venice it is frequently frozen over in winter. The dominion of this sea is claimed by the Venetians.

ADUAR, a travelling village, common in eastern countries, particularly among the Moors and Arabians. The inhabitants of which it is composed dwell in waggons and tents, for the conveniency of removal from place to place, on account of pasturage for their cattle. It is said that 30,000 villages of this description exist in the kingdom of Algiers; but this is perhaps an exaggerated statement.

ADVENTURE BAY, a bay in Van Diemen's Land, near the southern extremity of New Holland, was discovered by Captain Furneaux in 1773, and was visited by Captain Cooke in 1777. The bottom of this bay is bounded by a beautiful beach two miles in length, and covered with a fine white sand thrown up by the sea, and probably produced by the decomposition of sandstone rocks which appear on different parts of the coast. The elevated land in the vicinity is clothed with thick forests. The few natives who were seen, seemed to be extremely ignorant and barbarous. Their huts were miserably constructed; and no trace of boat or canoe was observed. The animals, especially birds and insects, of rich and beautiful colours, are numerous; the only quadrupeds are supposed to be the kangaroo, and a small species of opossum; snakes and lizards are common; the sea abounds with fish; and a lake of brackish water, situated in a plain not far distant from the beach, afforded bream and small trout to the voyagers.

ADVENTURERS, a society of merchants, formed for the discovery of new territories and sources of trade; had its origin in Burgundy, and was first established at Antwerp by John duke of Brabant, about the middle of the 13th century, where it was distinguished by the appellation of the *Brotherhood of St Thomas a Becket*. This association, which was partly composed of English merchants, derived various immunities from the sovereigns of England,—the privilege of exporting wool, from Edward I. about the end of the 13th or beginning of the 14th century;—a charter from Henry VI. in 1430;—the name of *Merchant-adventurers of London*, from Henry VII. in 1505;—and the form of an English corporation from Queen Elizabeth, in 1564. Such was the monopolizing spirit of the times, that this company claimed and exercised the right of granting licences to all other English merchants for the privilege of trading in the great fairs on the continent. The sum at first demanded for this licence was only 6s. 8d.; but in the time of Henry VII. it was raised to the enormous sum of L.40. Another association had now been formed, denominated the *Merchant-adventurers of England;* their application to parliament to be relieved from this heavy imposition was successful, and it was reduced to nearly the original tax.

ADVERB, a word conjoined with an adjective or verb, and expressive of some modification in that quality or action in the words with which it is associated; as *very* rich, *highly* favoured; he walks *quickly*.

ADVERSATIVE, a conjunction, denominated disjunctive, because it separates, or sets in opposition, different clauses of a sentence; as, he is extremely rich, *but* a great miser; in which *but* is the adversative conjunction.

ADULA, the ancient name of one of the summits of St Gothard, one of the Swiss Alps, which gives origin to the river Rhine.

ADULARIA, a crystallized and transparent variety of felspar, derives its name from the mountain Adula, which affords fine specimens of this mineral. See Mineralogy.

ADULTERATION, from a word signifying to corrupt, is the act of debasing or corrupting any substance by an admixture of something of inferior value. Adulteration of the necessaries and luxuries of life is subjected to the penalties of fine and imprisonment. Adulteration of the *coin* is effected by forging another stamp or inscription; by increasing the proportion of alloy with the gold or silver; by substituting a different metal; or by diminishing its size, by clipping, filing, &c. This offence is severely punished among all nations. By the Egyptians, the offender had both hands cut off; and by the Romans, at one period, he was thrown to wild beasts. In the time of Constantine, it was declared to be treason, as it is at the present day in Britain.

ADULTERY, the violation of conjugal fidelity, by an unlawful connection between a married and an unmarried person, or between two married persons. The different degrees of criminality or moral turpitude, in the estimate formed of this offence by different nations, and by the same nation at different periods of barbarism and refinement, have produced a remarkable diversity in the penal enactments against it. Among early nations, the severest punishment was inflicted. It was punished by death among the Jews; by death or mutilation, by the loss of nose, eyes, or ears, among the Greeks; by a similar mutilation, at one period, among the Romans, and at another period by death. By the older laws of almost all European nations, the punishment was also capital; but the laws have become obsolete, or are greatly mitigated. In England, death, banishment, mutilation, and, in the present day, a pecuniary fine, have been the different punishments annexed to this crime. In Scotland, in the 16th century, open cohabitation or *notour* adultery, was punished by the forfeiture of goods; but it was soon after rendered capital; and in the succeeding century, several offenders of this description were actually executed. In cases of simple adultery, pecuniary damages are awarded, as in England. The injured party may obtain a divorce by act of parliament in England, and by an action in the commissary or consistorial court in Scotland. The offending wife loses her rank or title acquired by marriage; and the offending husband must return the dowry of his wife. The law of Scotland prohibits the offending parties from marrying. The marriage between such parties is permitted in England, unless, as we believe happens in some cases, a special enactment to the contrary be introduced into the act of parliament authorising the divorce.

The prevalence of this offence, for it is scarcely regarded as a crime, and the mitigation of the penalties annexed to it, form a striking feature in the manners of modern times, and might afford useful employment to the researches of the moralist and legislator in investigating its causes, and considering the means of its prevention. It would appear, at first sight, that those who have been guilty of deliberate seduction,—of embittering the sweets of domestic joy,—of entailing misery, not on one, but on several innocent families, could not be too severely punished. But, on the other hand, it is strenuously maintained, that excessive severity of punishment is not the surest and most effectual means for the prevention of crimes; and on this principle the penal practice of this country, in such cases, proceeds. The expression of public opinion in reprobating the guilt of adultery, is altogether disproportionate, in the estimation of the sober-minded and dispassionate, to the enormity of the offence. The female offender, it is true, is, in some degree, avoided by the virtuous of her own sex; but the male delinquent, in few instances, suffers any degradation in society: his honour, in the fashionable meaning of the term, has contracted no stain, and he is freely admitted and courteously treated in all polished circles.

ADVOCATE, a person who pleads or defends causes in courts of law. In England, the term *counsel*, or *barrister at law*, and in Ireland *counsellor*, is applied to persons of this profession; but *advocate* is the common appellation in Scotland. The members of the faculty of advocates have the exclusive privilege of pleading before the supreme civil and criminal courts in Scotland, as well as in every civil and ecclesiastical court. They enjoy the right also of pleading before the king in council, and the two houses of parliament. From this body, the judges of the supreme civil and criminal courts, and those of the court of exchequer, as well as the sheriffs of counties, which latter must be advocates of three years standing, are appointed. The faculty of advocates consists of nearly three hundred members, and possesses an excellent library, containing not fewer than 70,000 volumes. This library is entitled to a copy of every book entered in Stationer's Hall; and L.100 sterling of the admission-money of new members is appropriated to the purchase of books.

Candidates for the profession of an advocate undergo three trials. The first is an examination, which is conducted in the Latin language, of their knowledge of the Roman or civil law; the second examination, after the lapse of a year, refers to their knowledge of the law of Scotland; and in the third a Latin thesis is defended.

ADVOCATE, *Lord*, or *King's* advocate, one of the officers of state, and principal crown lawyer in Scotland. He is the public prosecutor before the Court of Justiciary, or supreme criminal court. The Lord Advocate has the power of determining, from the evidence of facts and circumstances laid before him, whether persons charged with crimes shall be prosecuted; and in crimes of a capital nature, he has the power of restricting the sentence to an arbitrary punishment, or a punishment at the discretion of the judge, which does not extend to death.

ADVOCATION, *Bill of*, in the law of Scotland, is a petition of appeal of a party in an action before an inferior court to the supreme court. Letters of advocation are the decree or warrant of the Court of Session, discharging the inferior court from further proceedings in the cause, and advocating it to itself.

ADVOWEE, anciently the advocate of a church, or religious house, who was the guardian and administrator of its temporal affairs. This office is said to have been first introduced about the fourth century; and persons of the highest rank were appointed to it, for the purpose of defending with arms, or of protecting with power and authority, the establishments to which they were nominated. The Emperor Charlemagne held the title of advowee of St Peter's; and the Pope constituted Edward the Confessor and his successors advowees of the monastery of Westminster, and of all the churches in England. Sub-advowees were sometimes appointed in monasteries as substitutes for the advowees.

ADVOWSON, is the right of presentation to a vacant benefice in England. An advowson is said to be presentative, when the patron presents a person to the bishop to be instituted in his church. It is called *collative*, when the benefice is given by the bishop as the original patron, or by means of an acquired right; and *donative*, when the patron, by a single donation in writing, grants possession, without presentation, institution, or induction. Advowson is equivalent to patronage in Scotland.

ÆACEA, were solemn festivals and games, which were celebrated in the island of Ægina, in honour of Æacus.

ÆACUS, the son of Jupiter and Ægina, and king of the island, named after his mother. According to fabulous history, after the island of Ægina was depopulated by a plague, the grief of Æacus drew forth the compassion of Jupiter, who converted all the ants into human beings, who were hence called *myrmidons*, from the Greek word which signifies an ant. But the story, divested of fable, is supposed to refer to Æacus, a wise and prudent prince, who roused the exertions of the inhabitants, to recover, by industry and commerce, the losses which they had sustained by the plunder of pirates. Æacus was so highly esteemed for his love of integrity and justice, that Pluto, the god of the infernal regions, appointed him one of the judges of the dead:—another moral lesson wrapped up in fable, which teaches that the practice of virtue will be honoured and rewarded hereafter.

ÆBUDÆ, or Hæbudæ, the ancient name of the Western Islands of Scotland. The more modern name Hebrides, is supposed to have originated from the conversion of the *u* into *ri*, by the inattention of some transcriber.

ÆDILE, a magistrate among the Romans, to whose superintendance almost the whole of the public police of the city was entrusted. Two ædiles were originally chosen from the plebeian order, to assist the tribunes of the people in their duties. The office of the ædiles, as the word, signifying a building, from which it is derived, imports, was to take care of, and superintend the city, its public buildings, roads, markets, weights and measures, prices and quality of provisions, the censorship and inspection of books, particularly of dramatical performances. They possessed also a certain jurisdiction in determining causes of an inferior nature. It was also a part of the duty of the ædiles to guard against any innovation in religious ceremonies; and to see that the ordinances of the people, and the decrees of the senate, were safely deposited in the temple of Ceres. The exhibition of public games, at their own expence, was also required from the same magistrates, which was attended with the ruin of many individuals who held that office. But when the senate had decreed, on the occasion of the differences between the patricians and plebeians being settled, that games should be celebrated in a splendid manner, in gratitude to the gods for this event, the ædiles declined to undertake the task, on account of the enormous expence. The patricians came forward, and offered to take charge of the festival, if they were admitted to the office. Two ædiles of the patrician order were then elected, about the year of Rome 388, and were called *ædiles curules;* because in the administration of justice they sat in a chair ornamented with ivory, while the plebeian ædiles sat on plain benches. Besides these four ædiles, Julius Cæsar created two others, who were distinguished by the name of *ædiles cereales;* because to their management and inspection were committed the public granaries, and all matters relative to corn.

ÆGÆ, or ÆGEA, or *Edessa,* the modern Vodina, was so called by Caranus, the first king of Macedonia, who had been directed by the oracle to establish his empire under the conduct of a flock of goats. He arrived in Macedonia during a storm, and pursuing a flock of goats, which ran to the city for shelter, he surprised and took it. He then changed the name to Ægea, derived from a word which signifies a goat; and hence, too, it is supposed, the he-goat, mentioned by the prophet Daniel, is the symbol of the kings of Macedon.

ÆGEAN SEA, is the ancient name of that part of the Mediterranean which separates Europe from Asia, and now called the Archipelago.

ÆGEUS, in fabulous history, was king of Athens, and the father of Theseus. The Athenians having put to death the son of Minos, king of Crete, Minos made war upon them, was victorious, and concluded a peace, with the severe condition of seven noble Athenian youths being annually chosen by lot, and sent to Crete, to be devoured by the Minotaur. On the fourth year, the lot fell on Theseus. The ship in which he departed was ordered to have black sails; and, in case of his death, it was to return with the same; but if he should be fortunately victorious, they were to be changed into white. Theseus killed the Minotaur, and returned, but neglected to change the sails; and the father, concluding that his son was dead, threw himself into the sea, and from this event it derived its name. Divine honours were decreed to Ægeus by the Athenians, who performed sacrifice to him as a sea god, the adopted son of Neptune.

ÆGINA, an island in the Saronic gulph, or bay of Engia, about 20 miles distant from Athens. Æacus changed its name from Œnopia to Ægina, in honour of his mother, who, according to the fable, was the daughter of Æsopus, king of Bœotia, was seduced by Jupiter, in the likeness of a lambent flame, and was carried from Epidaurus to this island, then a desert. The industry of the ancient inhabitants, in communicating fertility to a barren soil, obtained for them the name of *myrmidons*, or *ants*. They also applied themselves successfully to commerce, and are said to have been the first who coined money. They were rivals of the Athenians in naval power, and disputed the palm of victory with them at the celebrated naval engagement of Salamis. The remains of a magnificent temple, which was dedicated to Jupiter, and erected on a lofty mountain, at a distance from the sea, are still visible. Ægina fell under the power of different states of Greece at different periods. In 1536 it was conquered by the Turks; the capital was taken and burnt, and, after a dreadful massacre, the surviving inhabitants were reduced to slavery. Ægina produces corn, wine, olives, and almonds; and it abounds with pigeons and partridges. The latter are said to be so numerous, that the inhabitants, to avoid a famine, annually destroy their eggs.

ÆGINA, now called Engia, is the capital of Ægina, and only remarkable for a castle, which is capable of admitting about 800 troops, and thirteen churches, of mean appearance, some parts of which are supposed to be fragments of a temple of Venus.

The remains of temples, theatres, and public works, some of which are now under the surface of the water, afford ample proof of the ancient magnificence of this place.

ÆGIPHILA, Goat-friend, a genus of plants belonging to the class Tetrandria.

ÆGIS, a word signifying a she-goat, is the name of the shield of Jupiter and Minerva. Upon the death of the goat Amalthea, by which Jupiter was suckled, he covered his shield with its skin, and presented it to Minerva, and hence Minerva's shield was called *ægis*. Jupiter, according to the fable, restored the animal to life, covered it with a new skin, and placed it among the stars. Some antiquarians suppose that the ægis is not a shield, but a breastplate, as it is described by Virgil, Æneid, lib. viii. 435 and 354.

AEGOPODIUM, Goat-weed, or Goat's-foot, a genus of plants belonging to the class Pentandria.

ÆGOSPOTAMOS, the ancient name of a small river of the Thracian Chersonesus, which falls into the Hellespont. The road for ships near its mouth is famous, in ancient history, for a victory gained by the Lacedemonians under Lysander, over the Athenians under Conon. This complete overthrow was followed by the capture of Athens, the destruction of the naval power of the Athenians, and the termination of the Peloponnesian war.

ÆLIA CAPITOLINA, the name of the city built by the emperor Adrian, near the site of the ancient Jerusalem. In the year 134, when he visited the eastern parts of the Roman empire, the city being in ruins, he established a Roman colony in it, and dedicated the temple which he erected in place of that of Jerusalem, to Jupiter Capitolinus. To this was prefixed his own family name, which he gave to the city.

ÆLIAN CLAUDIUS, a learned Roman who was born at Præneste, in Italy, and flourished in the reign of the emperor Adrian. He was greatly distinguished as a Greek scholar, and was so perfect a master of that language that he could speak and write it with much facility and fluency. He was the author of numerous works on different subjects, the chief of which, *Various History*, and a *History of Animals*, in seventeen books, written in Greek, have been frequently quoted.

ÆNEAS, a celebrated Trojan prince, was the son of Anchises and Venus; Æneas and Antenor were the only persons among the Trojans who preferred peace to the long war which terminated in the destruction of Troy, and strongly urged that Helen, whose detention was the cause of the war, should be restored. This prudent counsel brought upon them the suspicion of treachery. When Troy fell into the hands of the Greeks, Æneas and his friends fought bravely against the assailants; and being overpowered by superior numbers, he escaped from the flames which raged in the city, carrying his aged parent, Anchises, on his shoulders, and leading his son Ascanius by the hand; but in his flight he lost his wife Creusa. Æneas and some of his surviving countrymen retired to mount Ida, built a fleet, set sail in search of a new settlement, and after many perilous adventures by sea and land, arrived at Sicily, where he lost his father. Driven by a storm to the coast of Africa, he was most hospitably entertained by Dido, queen of Carthage, who fell desperately in love with him, and solicited his acceptance of a share of the government of her kingdom. Rejecting her offer, he departed from Africa, landed in Italy, married Lavinia, the daughter of Latinus, king of the Aborigines, and built Lavinium, for the residence of his countrymen. But Turnus, king of the Rutuli, to whom Lavinia had been betrothed before the arrival of Æneas, being disappointed, and enraged at the preference given to a stranger, made war on Latinus and his new son-in-law. Latinus fell in battle, and the army of Turnus was routed. Æneas succeeded to the throne of Latium, and united both nations under the common name of Latins. Four years had only elapsed when Æneas was slain in battle with Mezentius, king of the Tuscans. The Romans trace their descent to Æneas; and after his death he was invoked as a god by the name of Jupiter Indiges.

ÆNEID, the name of Virgil's celebrated epic poem, which relates the adventures of Æneas and the Trojans, their establishment in Italy, and the foundation of the Roman empire. The Æneid is divided into twelve books, the first six of which are generally allowed to be the most interesting. It is said that the last six books were in an unfinished state, or, at least, had not received the last correction of the author at his death, and that he ordered the whole poem to be committed to the flames. Had the order been obeyed, polite literature would have sustained an irreparable loss. And whatever inferiority may be discovered by critics in the descriptions and characters of Virgil, when compared with the bolder and more striking beauties of Homer, of which they are obviously an imitation, the lovers of poetry must ever admire the Æneid on account of the correctness and elegance of its diction, and the smoothness and melody of its versification, as one of the most splendid and finished compositions.

ÆNIGMA, from a Greek word, which signifies to hint a thing darkly, is an obscure manner of expression, or representation, in which the words or figures employed convey a different meaning from their obvious and literal import. Exercises of this kind, from the prevalence of false taste, were at one time frequent among the learned; and, when alchemy flourished, the adepts described their processes in this ambiguous mode of expression, that their true nature might not be easily discovered.

ÆOLIAN HARP, or lyre, a musical instrument, from which the most delicate and agreeable tones are obtained by the impulse of the wind. For a description of this instrument see Acoustics.

ÆOLIAN ISLANDS, are seven islands which are situated between Sicily and Italy, and derive their name from Æolus, who is supposed to have reigned about the time of the Trojan war. They are now called *Lipari Islands*. See Lipari.

ÆOLIAN SEA, is part of the Ægean sea which washes the shores of Æolis, and is now called the gulph of Smyrna.

ÆOLIC, one of the five dialects of the Greek:

tongue, was first used in Bœotia, from whence it passed into Æolia. It approaches nearly to the Doric dialect.

ÆOLIPILE, signifying the ball of Æolus, is a hollow metallic ball, with a cylindrical pipe. When the ball is nearly filled with water, and the pipe screwed in, it is exposed to heat, and when the water boils, or is converted into steam, the steam rushes out with great violence and noise. When alcohol is introduced into a similar apparatus, a lower degree of heat converts it into vapour, the current of which is sometimes employed as a blowpipe.

ÆOLIS, or Æolia, a country of Asia Minor, which was formerly occupied by a colony of Greeks. According to some geographers, it now forms part of Anatolia.

ÆOLUS, a king of the Æolian islands, according to ancient history, succeeded his father-in-law in the government of these islands, and gave them his name. In the heathen mythology, Æolus is represented as the god of the winds, which he kept confined in a vast cavern; but the origin of the fable is said to be derived from the wisdom and prudence of Æolus, and from his skill in astronomy, and observing natural appearances, by which he could predict changes of weather, and the approach of storms. The Romans paid divine honours to Æolus, and he was considered as the son of Jupiter and Acesta.

ÆON, a word signifying an age, or certain period of duration, was employed by the Platonists to denote any virtue, attribute, or perfection; and hence the Deity was represented as an assemblage of all possible *æons.* This Platonic doctrine was introduced into the Christian faith in the first ages of the church, by different sects, and particularly by the Valentinians.

ÆRA, or era, a certain fixed point of time which is distinguished by some remarkable event, and to which both preceding and future events are referred. For example, the Christian æra, which commenced at the birth of Christ.

ÆRARIUS, a name given by the Romans to a citizen degraded on account of some offence. Persons of this description could not make a will, inherit property, vote in assemblies, or hold a place of emolument or honour; but while they were precluded from the privileges, they were still subjected to the taxes of the state.

AERIAL, in its general acceptation, signifies something which partakes of the nature and properties of air.

Aerial, *Perspective*, denotes the appearances of visible objects, as they are modified by distance, and varieties of light or shade; or, it is the art of imitating these appearances in painting. See Painting.

AERIFORM, a term expressive of something in the form or state of air; as the airs or gases, which are different from the common air of the atmosphere, are called in chemistry *aeriform fluids.*

AEROLITES, a word from the Greek, signifying air and stone, is applied to those mineral bodies which have fallen from the atmosphere, in which, according to some naturalists, they have been formed.

AERONAUT, a name applied to a person who sails through the air by means of a balloon.

AERONAUTICS, from two Greek words, signifying air, and the art of sailing, is the art of navigating the atmosphere with balloons.

AEROSTATION.

Aerostation, in its original meaning, signifies the pressure or equilibrium of the air; but, in a more general acceptation, it has been applied to the art of navigating the atmosphere by means of balloons.

Early History.—Those who are fond of retracing the progress of arts to remote antiquity, may probably think their researches rewarded with the discovery of the origin of aerial navigation, or, at least, of the first attempts at flying in the air, in the story of Dædalus, who, it is said, constructed wings for himself and his son; and, to escape the resentment of Minos, king of Crete, by whom they were kept in durance, flew from that island to Sardinia, and afterwards to Cumæ, in Italy. But, perhaps, the whole of this ancient fiction ought merely to be regarded as the expression of an ingenious invention, or an arduous enterprise, clothed in fable. Few nations, however, exist, among whom, even in the earliest times, certain vague notions have not prevailed of the practicability of traversing the air; but this power was generally ascribed to the agency of supernatural beings. Roger Bacon, an English monk, who died before the termination of the thirteenth century, seems to be the first who speculated on this arduous enterprise upon rational principles. He says, that a machine had been constructed for the purpose, and that the experiment had been successfully made by a person whom he knew. This machine is said to have consisted of two large hollow globes of thin copper, exhausted of air.

About the middle of the seventeenth century, John Wilkins, bishop of Chester, who had distinguished himself by his mathematical and physical learning, published a treatise, entitled "The Discovery of a New World;" in which he asserts, that it might be possible to reach the moon, if the earth's attraction were once overcome. He states also the general principle, that a vessel filled with lighter air, will float and rise in heavier air; but he refers particularly to mechanical contrivances for traversing the air, and thinks that a flying chariot might be constructed on mechanical principles.

Francis Lana, a Jesuit, who was contemporary with Bishop Wilkins, proposed a method of flying in the air, similar to that of Friar Bacon. His method was to construct four globular vessels of thin copper, each twenty feet in diameter, and these vessels being exhausted of air, would float in the atmosphere, and support a certain weight. But although the principle be correct, it could not be put in practice, as no vessel sufficiently thin to float in the air, could resist its pressure when exhausted.

In the year 1709, a singular and complicated flying machine was constructed by a Portuguese friar, of the name of Gusman. This machine was in the form of a bird, was furnished with tubes, through which the air passed, to fill its sails or wings, and, when the wind was deficient, by means of bellows concealed within its body, for the purpose of raising it in the air. Pieces of amber were fixed in the upper part of the machine, and magnets were inclosed within spheres, that its elevation might be assisted by electric and magnetic attraction. It does not appear, nor indeed is it probable, that this machine answered the purpose; but the inventor was rewarded with a liberal pension during his life. In the year 1736, it is said that Friar Gusman constructed a wicker basket, of seven or eight feet in diameter, which was covered with paper, and which rose about 200 feet in the air; and, it is added, that this effect was generally ascribed to witchcraft.

In the year 1755, Joseph Galien published a small treatise at Avignon in France, entitled, "The Art of Navigating the Air," in which he mentions, that a bag of cloth or leather, containing air lighter than that of the atmosphere, might be employed for the purpose of aerial navigation; but the knowledge, or means of preparing such an air, were not within the reach of the author.

The discovery of inflammable air, or hydrogen gas, by Mr Cavendish, in 1766, was the first approach to any successful attempts in aerial navigation; and Mr Cavallo was the first who made experiments with this air. But having tried bladders and Chinese paper, both of which failed, he succeeded only in blowing up with this air soap-bubbles, which rose rapidly to the ceiling, and burst, by striking against it. This experiment was made in the year 1782. In one account of the origin and early history of balloons, it is stated, that a similar experiment with bags of thin silk and paper, filled with hydrogen gas, was devised and attempted by the brothers Montgolfier, and that the bags thus prepared ascended rapidly to the ceiling; but, from the sudden escape of the gas, in a few seconds fell to the ground.

First Fire Balloon.—The brothers now alluded to, Stephen and Joseph Montgolfier, were proprietors of a paper manufactory near Annonay in France, and had particularly directed their attention to this subject, about the middle of the year 1782. The ascent of smoke and clouds in the atmosphere, seems first to have suggested the plan of including an artificial cloud in a large bag, of a thin and light material, which being specifically lighter than the air, would float in it. In the month of November of the same year, the experiment was made by Joseph Montgolfier at Avignon. He prepared a silk bag, of a parallelopiped form, and containing about forty cubic feet. Burning paper was applied to an aperture of its lower extremity, the internal air was rarified, and the bag expanding, rose rapidly to the ceiling of the apartment in which the experiment was made. A similar experiment was repeated in the open air, and the bag rose to the height of seventy feet. In another experiment, a bag of 650 cubic feet capacity was constructed, and when the air was rarified, it expanded, and burst from the ropes by which it was held, and reached an elevation of 600 feet.

On the 5th of June 1783, the first public exhibition of the ascent of a balloon took place at Annonay, in presence of an immense assembly of spectators. A bag of a globular form, constructed of linen, lined with paper, and having a capacity of more than 23,000 cubic feet, was found capable of raising 500 pounds, including its own weight. Chopped straw and wool were burnt under the aperture of the balloon. It immediately began to swell; and in five minutes, when it was fully expanded, its ascensive power could scarcely be counteracted by the united strength of eight men; and when it was liberated, it rose rapidly, amidst the enthusiastic acclamations of a countless multitude, to the height of a mile, was carried along by the current of wind, and, after being suspended in the air ten minutes, it fell to the ground a mile and a half distant from the place of ascent. This extraordinary exhibition made a strong impression on those who witnessed it; and as the news was circulated through Europe, various sentiments were excited; for, while the accuracy of the statement was doubted by some, the relation was altogether disbelieved by others.

First Balloon with hydrogen gas.—In August following, a subscription was set on foot at Paris, to defray the expense of an inflammable air balloon. Two brothers of the name of Robert, under the direction of M. Charles, a professor of experimental philosophy, constructed a balloon of thin silk, varnished with a solution of elastic gum. It was of a globular shape, about thirteen feet in diameter, and it was distended with hydrogen gas obtained from 1000 pounds weight of iron filings, and 500 pounds of sulphuric acid diluted with water, and conveyed into the bag through leaden tubes. But as this was the first attempt at the preparation of so large a quantity of hydrogen gas, from their inexperience in the proper manipulations, several days elapsed before it was filled; and as the gas was introduced into the bag without having passed through water, the heat and fumes of sulphurous acid with which it was impregnated greatly injured the silk. The distension was at last completed, and it rose to an elevation of 100 feet, where it was kept suspended; but as the public exhibition of its ascent was not to take place till next day, it was conveyed at the still hour of midnight, by torch light, and under a military escort, to the Champ de Mars, two miles distant. The day following, which was the 27th August 1783, an immense multitude of spectators assembled from all quarters, and covered every accessible spot, to witness a spectacle so new and unexpected. In the afternoon, the discharge of a cannon announced the completion of the preparations; and when loosened from the ropes, it instantly rose; and its rapid ascent to the height of 3000 feet was followed by one universal burst of acclamation from the astonished multitude. It passed through a mass of clouds, reappeared at a greater elevation, was again lost to view in another cloudy region; and having floated in the air for three quarters of an hour, fell in a field at the distance of fifteen miles from the place of ascent. A rent was observed in its upper part by the peasants who took it up; and to this the fall was ascribed.

Fire Balloon ascends from Versailles—Invited by the Royal Academy of Sciences to exhibit the experiment in their presence, and at their expense, Joseph Montgolfier arrived in Paris about the beginning of September of the same year, and constructed a balloon of coarse linen, lined with paper. It was of an oval form, 75 feet in height, and 43 feet wide; was fully inflated in ten minutes, by burning 50 pounds of chopped straw and 12 pounds of wool, and was found capable of raising 500 pounds from the ground. The succeeding day was fixed for the public exhibition; but a stormy night intervening, entirely demolished the machine; and it required five days to replace it with another, which was painted and ornamented with various figures and devices. On the morning of the 19th of September, it was brought forward and placed upon a scaffold, in front of the palace of Versailles; and, in a short time, every place from which the ascent was expected to be seen was crowded with an immense multitude of spectators of every rank and description, not only from the capital, but also from the surrounding country. After the royal family and their suite had examined the apparatus, the discharge of a mortar announced the commencement of inflating the balloon. In ten minutes it was completely filled; and a basket, in which were placed a sheep, a duck, and a cock, was attached to it. Another discharge of the mortar was the signal of cutting the ropes, when it ascended with a majestic motion, and somewhat in an oblique direction, to the height of 1500 feet. At that point it seemed for a short time stationary; and after being eight minutes in the air, fell to the ground at the distance of two miles. The animals, the first carried through the air by this new vehicle, escaped uninjured, and the sheep, when found, was quietly feeding.

De Rozier the first aeronaut.—Another balloon, nearly of the same dimensions, was afterwards prepared, of a stronger and better construction, by M. Montgolfier; and Pilatre de Rozier, an enterprising young naturalist, offered himself to be the first aerial adventurer. When the balloon was inflated, and the car attached, de Rozier placed himself in it, and it rose to an elevation of 300 feet, as high as it was permitted by the length of the ropes by which it was held. It remained suspended for a few minutes at this height, and with a gentle motion returned to the ground. Similar experiments were repeated by the same naturalist; and during his descent in one of them, the balloon fell among some trees, in the branches of which it was entangled; but by feeding the fire with fuel, he dexterously extricated himself, rose to a greater height, and at last descended in a more commodious spot.

The successful issue of these experiments shewed that the dangers of navigating the air, by machines of this description, were of a less formidable nature than was at first apprehended, and that the aeronaut possessed the means of rising in the atmosphere, by supplying the balloon with rarified air, and throwing out ballast, and also of descending, by allowing the air within the machine to cool and be condensed; and afforded sufficient encouragement to bolder and more arduous attempts. It was justly supposed, too, that the balloon being held down by cords, subjected it to irregular motions, and thus exposed the voyager to serious accidents. With all this in view, an aerial voyage was determined on, in which the machine should be at full liberty, or left to the guidance of the navigators. And here the adventurous Pilatre de Rozier presented himself to undertake the arduous task.

First aerial voyage.—The 21st of November 1783 was the day fixed for this grand experiment. The weather was unfavourable; and the balloon was nearly destroyed by the violence of the wind; but in two hours, by the activity of the workmen, the injury was repaired; and the preparations being completed, De Rozier and the Marquis d'Arlandes, who accompanied him, seated themselves in the car, which was also furnished with ballast and materials for fuel. The weight of the whole apparatus was estimated at 1600 pounds. At two o'clock the balloon was liberated, and its majestic ascent excited the varying emotions of anxiety, wonder, and amazement, from the astonished spectators; and when the adventurers, soaring aloft, waved their hats, the salutation was returned with a general burst of acclamation from the admiring multitude. The balloon rose to the height of 3000 feet; was visible to the inhabitants of Paris during the greatest part of the voyage; and having traversed a space of more than five miles in 25 minutes, it descended safely to the earth.

The happy termination of this daring expedition could scarcely fail to excite feelings of the deepest interest. All who witnessed the exhibition were gratified with a most impressive spectacle; but the philosopher hailed it as the era of a new acquisition to the power of man. He had long beheld him familiar with the bold enterprise of penetrating the depths of the ocean; and now he could contemplate the same adventurous spirit in pursuing his excursive flights through the regions of the air. But those who saw and described this extraordinary scene, were not restrained by such sober reflections. The volatile fancy of the Parisians magnified the fleeting shadow of the balloon on the towers of a lofty edifice of the city into the exact representation of a total eclipse of the sun! And a historian of the same expedition, after the lapse of more than 30 years, indulging in the reveries of a heated imagination, has discovered an apt illustration of this aerostatic voyage, in the flight of the arch-fiend from Milton's infernal abodes; and the French aeronauts, like the Satan of that sublime poet, are uplifted "*in the surging smoke!*"

But, amidst the general exultation which pervaded all ranks of the French nation, a more substantial remuneration than empty applause awaited the brothers Montgolfier. The Academy of Sciences bestowed upon them the annual prize of 600 livres; the elder brother was raised to the rank of nobility; and the younger, while he was rewarded with a pension, had 40,000 livres placed at his disposal to support the expence of farther experiments.

Second voyage.—A keen rivalship now arose between the partizans of aerial navigation by means of rarified air, and those who preferred the method of filling balloons with hydrogen gas. The complete success of the late experiment gave a considerable preponderance in public estimation to the first system; but those who opposed it, confident of the superior advantages and ultimate result of their own method, determined to bring the matter to a practical test. The undertaking was entrusted to M. Charles and the brothers Robert; and the expence of the exhibition, which amounted to L.400, was defrayed by subscription. A balloon, of a spherical form, and 28 feet in diameter, was constructed of thin silk, or tiffany, varnished with a solution of elastic gum. A net was stretched over the upper hemisphere, and was fastened to a hoop, or band, which surrounded the middle of the balloon; and, a few feet under it, a car, for the reception of the voyagers, was suspended by ropes attached to the hoop. The car, constructed of wicker work, which was covered with painted linen, elegantly ornamented, was eight feet in length, four feet in breadth, and three and a half in depth. A valve was placed in the upper part of the balloon to permit the free escape of the gas; and a long silken tube was attached to its lower part, by which the balloon was to be filled. Various difficulties retarded the exhibition till the 1st of December 1783; when the balloon, and the apparatus for the preparation of the gas, were brought to a spot near the Thuilleries, which was chosen as the place of ascent. The materials employed in the production of the hydrogen gas, were diluted sulphuric acid and iron turnings. They were introduced into several wooden casks, arranged round a large cistern of water, in which was inverted a vessel for the reception of the gas, which, having previously passed through the water, was conveyed by leaden pipes to the balloon. The weight of the whole machine, including the ballast and travellers, amounted to 640 pounds; and, by calculation, it was found, that the air with which the balloon was distended was only $5\frac{1}{4}$ times lighter than atmospheric air.

It was near two o'clock before the preparations were fully completed. Messrs Charles and Robert then seated themselves in the car; and the balloon being unloosened, rose with a slow and steady motion. In the enthusiastic description of the narrator, it ascended "amidst profound silence and admiration, and permitted the spectators, of which the number was immense, to follow with their eyes and hearts two interesting men, who, like demigods, sought the abode of immortals, to receive the reward of intelligence, and carry the imperishable name of Montgolfier." The balloon soon reached the height of 2000 feet; and, by discharging a quantity of ballast, or opening the valve to allow the air to escape, they rose or descended at pleasure; but during the whole excursion, which continued for an hour and three quarters, they kept pretty nearly at the same height from the earth. At last they resolved to terminate their excursion, and they alighted safely, at the distance of 27 miles from Paris.

But although the balloon had become flaccid by the expenditure of air, when the voyagers dismounted from the car, it appeared still to possess a considerable ascensive power. This determined M. Charles to attempt alone another voyage. The machine being lightened 130 pounds, by M. Robert leaving the car, it ascended with such velocity, that, in ten minutes, it reached an elevation of 9000 feet. At this height, every object on earth disappeared from his view. When he left the earth, the sun had just set; but as he rose in the atmosphere, that luminary became again visible; and he had an opportunity of watching his parting rays as he sunk a second time below the horizon. An impressive scene now presented itself: vapours ascending from the earth, collected into clouds, of various fantastic forms; and the pale light of the moon, which had just risen, communicated a thousand varying hues. At this time he observed the balloon having a whirling motion, and, by the effect of a contrary current of air, returning in an opposite direction; and when the progress was horizontal, he was surprised at seeing the streamers of his banners pointed upwards,—an effect which must have been produced by an ascending current of air. When the balloon first rose, the thermometer stood at 41°, but at its greatest elevation it sunk to 21°. This great change of temperature produced considerable inconvenience; his fingers were benumbed with cold, and he experienced a violent pain in the jaw and ear of one side. During the higher part of his ascent, the balloon was greatly distended, and, to avoid the danger of bursting, he frequently opened the valve, when the air escaped with a rushing noise, and, being of a higher temperature than the air of the atmosphere, diffused a considerable warmth around; but the approach of night, and the recollection of the promise to his friends of returning in half an hour, warned him to discontinue his excursion. He therefore opened the valve, and descended slowly. The discharge of a few pounds of ballast within 200 feet of the earth, rendered the balloon nearly stationary; and having performed, in 35 minutes, a circuitous course of nine miles, he alighted safely in a field, at the distance of three miles from the place of ascent.

Third voyage.—On the 19th of January 1784, Joseph Montgolfier, Pilatre de Rozier, and four other persons, ascended from Lyons in the largest balloon which has yet been constructed. This balloon was of an oval form, above 130 feet in height, and 105 feet in width; it was formed of a double fold of linen, having three intermediate layers of paper. The expence of this exhibition, which amounted to L.180 Sterling, was defrayed by subscription. This immense balloon, when distended with rarified air, had so great an ascensive power, that it required the strength of 50 men to retain it. In seventeen minutes it was sufficiently dilated by the combustion of 550 lbs. of alder faggots; and the six adventurers having placed themselves in the car, it rose into the atmosphere, and continued for more than half an hour over the city; but having observed a large rent in the upper part of the balloon, they found it necessary to return to the earth, which they reached without sustaining any injury.

Blanchard's voyage.—M. Blanchard, who was distinguished afterwards by his aerostatic excursions, and who had long occupied his ingenuity in mechanical contrivances for the purposes of flying in the air, now contemplated the successful application of the same principles in the direction of balloons. In his first attempt on the 2d of March, from Paris, with a balloon filled with hydrogen gas, through the officious interference of a person who insisted on being the companion of his voyage the apparatus was injured, and the balloon, after rising a few feet, returned to the earth with a severe shock. The curiosity of the intrusive stranger was now fully gratified, and he resigned the entire possession of the car to Blanchard, who ascended alone, and rose rapidly to an elevation of more than a mile; and after a voyage of an hour and three quarters, in different currents of air, he descended safely to the earth. But it did not appear that he derived any other advantage from his apparatus of oars and rudder than being able to communicate a whirling motion to the balloon.

Guyton-Morveau's ascension.—In the month of April the same year, M. Guyton-Morveau, celebrated for his chemical researches, and the Abbe Bertrand, ascended from Dijon, with a balloon constructed of varnished silk, and filled with hydrogen gas. The balloon was of a spherical form, 29 feet in diameter, and was furnished with an apparatus for the purpose of directing its course, It was launched at five o'clock in the evening, and soon rose to the height of more than 10,000 feet, where the cold was pretty intense. In this lofty situation, they beheld an extensive ocean of clouds floating below them, and enjoyed the splendid spectacle of a parhelion, or mock sun, composed of numerous concentric circles of varied hues; and having continued their excursion for an hour and a half, they returned safely to the earth, at the distance of 18 miles from Dijon. In their attempts to steer or direct the course of the balloon, they were not more successful than Blanchard. The same chemist, accompanied by another person, ascended with the same balloon on the 12th of June, at seven in the morning. They reached the height of 6,000 feet, and alighted 12 miles from Dijon.

Voyage of the Duke of Orleans.—A similar attempt was made in directing the course of a balloon, in the construction of one by the brothers Robert, at the expence of the Duke de Chartres, and afterwards better known as the Duke of Orleans. This balloon was 56 feet in height, and 36 in diameter; and it was supposed that this form would render it more manageable, at the pleasure of the voyagers. It was also furnished with oars and a rudder; and, besides, a small balloon was introduced, for the purpose of being filled, by means of bellows, with common air. The object of this small balloon was to supply the means of descent, without the expenditure of the hydrogen gas, with which the large balloon was filled. On the 19th of September, when the preparations were completed, the Duke of Orleans, the two brothers, and a fourth person, placed themselves in the car, which was also loaded with 500 pounds of ballast. The balloon rose slowly; and when they had reached the height of 1400 feet, the aeronauts were in no small degree alarmed at the gloomy appearance of thick clouds rolling along the horizon, and indicating the near approach of a thunder-storm. Some distant peals of thunder were heard, and they were driven about for some time by a whirlwind. A sudden change of temperature, of not less than 16°, produced a rapid descent of the balloon, which at one time was only about 250 feet from the tops of the trees of a forest; but the discharge of 40 pounds of ballast instantly reversed its progress, and it soon ascended to the height of 6,000 feet. A sublime scene now presented itself. A wide ocean of clouds, exhibiting every fantastic shape, extended below them, and seemed to preclude their return to the earth, while the balloon continued to be greatly agitated. In the alarm excited by their perilous situation, the cords by which the interior balloon was suspended, were cut, and it fell upon the aperture for the escape of the gas from the large balloon, and shut it up closely. Ascending higher, they surmounted the stormy region, and the sun, unobscured by a cloud, shone full upon them. But the influence of his rays produced such an expansion of the hydrogen gas, that they were every moment apprehensive of a rupture of the balloon. To permit the escape of the inflammable air, the Duke of Orleans pierced the lower part of the balloon in several places with his sword. The descent now was extremely rapid, and they narrowly escaped falling into a lake, by quickly discharging a considerable quantity of ballast; but after an excursion of five hours, and having traversed a space of 150 miles, they reached the earth in safety. In this voyage, a remarkable difference in the temperature of the external air, and of the air within the balloon, was observed. The hydrogen gas was at 104°, while the air of the atmosphere was only 63°.

First Female aerial voyager.—A fire balloon, or *Montgolfier*, as aerostatic machines on this principle were sometimes denominated, of an oval form, and 75 feet high, was constructed at Lyons, and ascended on the 28th of June 1784, in presence of the King of Sweden, who was then travelling in France. The adventurous aeronauts were Madame Thiblé, the first female who attempted such a voyage, and M. Fleurant. The balloon rose with such velocity, that in six minutes the objects on the earth were scarcely visible; its utmost elevation exceeded 13,000 feet; and having traversed six miles in three quarters of an hour, they alighted safely on the earth. The falling of a flag with its staff, of 14 pounds weight, affords some notion of the great height which they had reached; for it required seven minutes from the time of being projected from the car till it reached the ground. In this voyage, the different currents of air, in different regions of the atmosphere, were distinctly perceptible; and when the balloon passed from one current to another, it acquired an irregular or undulatory motion. In the succeeding month of July, another large fire balloon was constructed by order of the French king, and ascended from Versailles in presence of the Swedish monarch. De Rozier and Proust were the enterprising voyagers. They soon rose to the height of more than 12,000 feet, and were involved in an ocean of white clouds. The thermometer sunk to 25°; and, at this temperature, as might be expected, they were covered with a thick shower of snow, while it rained on the earth. Leaving these wintry regions, they descended to contemplate the more agreeable scenes of the verdure and luxuriance of summer; and, after an hour's excursion, alighted safely at the distance of 26 miles from Versailles.

Aerostation.

First Balloon in England.—The exhibition of balloons was not now confined to France, but, long before the period to which our narrative reaches, had extended over the greater part of Europe. Count Zambeccari, an Italian, sent up the first balloon in England, nearly a year after the earliest attempts had been made in France. This balloon was of a spherical form, ten feet in diameter, and was constructed of oiled silk; and being all over finely gilded, it presented, on its full expansion, the attractive appearance of a golden ball floating in the air. It was filled with hydrogen gas at one o'clock on the 25th of November 1783; it ascended from the artillery ground in London, in presence of an immense multitude of spectators, and having remained in the atmosphere for the space of two hours and a half, it came to the earth, in Sussex, at the distance of 48 miles. In December of the same year, Mr Sadler constructed a balloon, which was filled with hydrogen gas, and sent up from Oxford; and, in the summer following, the same aeronaut prepared another balloon, which was 18 feet in diameter, was filled with hydrogen gas, and was sent up from the same place with a dog. The balloon burst in the air, but the animal came to the ground unhurt, at the distance of a quarter of a mile.

First aerial voyage in Britain.—Beside those which we have noticed, other experiments of a similar description were made in different parts of this country. But the first aerial voyage in Britain was performed by Lunardi, an Italian, who ascended from London on the 21st of September 1784. The balloon which he employed on this occasion was constructed of alternate stripes of red and blue oiled silk. It was 33 feet in diameter, of a pear shape, and was filled with hydrogen gas. The same active adventurer repeated the experiment in various parts of England; and in the succeeding year he ascended in Scotland; and he was the first person who gratified the inhabitants of Glasgow and Edinburgh with the interesting spectacle of an aerial excursion.

Aerial voyage across the English Channel.—Blanchard, whose ascension with a balloon from Paris, and his contrivances for directing its course, have been already noticed, had arrived in England for the purpose of exhibiting similar experiments. His most adventurous excursion from Dover to Calais was accomplished on the 7th of January 1785. In this voyage he was accompanied by Dr Jeffries, an American gentleman. The morning was clear and frosty, and the wind, which was scarcely perceptible, was from N. N. W. The preparations for filling the balloon with hydrogen gas commenced at ten o'clock; and in two hours and a half it was thought to be sufficiently distended for the voyage. At one o'clock, M. Blanchard and his companion being seated in the car, it was pushed off from Dover Cliff; and they were no sooner launched into the air than they found it necessary to discharge a considerable portion of their ballast. The balloon then rose with a slow and gentle motion, and afforded them a charming prospect of the southern coast of England. But their progress towards the French coast was greatly retarded by the stillness of the air. Having passed over several vessels, and after being nearly an hour in the atmosphere, the balloon began to descend, which required a fresh portion of ballast to be discharged; and, as the descent still continued with accelerated velocity, the whole was thrown out; but as this had no effect in retarding their progress towards the water, they threw out a parcel of books. This produced a temporary ascent; and they were now midway between England and France. In a short time, the balloon began again to descend, when the remainder of their books and provisions, and every thing that could be spared, were thrown out. A bottle, in its descent, emitted, with a rushing sound, a steam like smoke, and when it struck the water the shock was perceptibly felt on the car and balloon. The ascensive power of the balloon was now so greatly diminished, that all this loss of weight was insufficient to counteract its descent; they therefore parted with their anchors and ropes, and having stript off their clothes, they secured themselves with slings, with the intention of cutting away the car. But they had now the satisfaction to observe the balloon rising and approaching the French coast; and, as they passed over the high land between Cape Blanc and Calais, it attained a greater elevation than in any part of their course. After a perilous voyage of nearly three hours, they descended safely on a vacant spot in the forest of Guiennes, not far distant from Calais, where they experienced the kindest and most hospitable reception.

Disastrous fate of De Rozier and Romaine.—It seems to have been a considerable object of attention with the French naturalists, to construct aerostatic machines in such a manner as to give the aeronaut the power of remaining in the atmosphere, or of descending at pleasure, without the expenditure of the hydrogen gas, or of the necessary ballast. The introduction of a small balloon filled with common air, had been tried, and failed. A combination of the principles of the two kinds of balloons was now proposed, and the plan was unfortunately executed by the adventurous Pilatre de Rozier. It seems probable, too, that the perilous voyage of Blanchard and his companion might have led to the adoption of the contrivance, which, in the end, proved fatal to the voyagers. The aerial excursion which, on this occasion, was projected by De Rozier, was to cross the channel from France to England. For this purpose, two balloons were employed; one of them, about 37 feet in diameter, was filled with hydrogen gas, and the other, which was distended with rarified air, had an ascensive power equal to 60 pounds. The fire balloon was suspended below the other, and at such a distance as to remove every apprehension of danger from the fire; but a short time only had elapsed after their ascent, when the spectators perceived, not without anxiety, the upper balloon, which was filled with hydrogen gas, rapidly distending, while the aeronauts were observed pulling the valve, and making other exertions to allow the hydrogen gas to escape. Soon after, the whole apparatus appeared to be on fire; no explosion was heard, and the fire balloon continued for about a minute expanded; it then suddenly collapsed, and the remains of the machine descended from the height of three quarters of a mile,

Aerostation.

and fell to the ground, with the unfortunate travellers, who were killed on the spot.

Aerial voyage of M. Testu.—The aerial excursion of M. Testu, for the time which he continued floating in the atmosphere, a period of twelve hours, is unequalled in the history of aerostation. With a balloon 28 feet in diameter, filled five-sixths with hydrogen gas, and fitted with wings and other apparatus for steering, he ascended from Paris, at four o'clock in the afternoon of the 18th June 1786. The day was cloudy, and there was some appearance of rain. When the balloon attained the elevation of nearly 3000 feet, it became so much distended as to excite in the voyager considerable apprehensions of a rupture; and as he was anxious not to lose any part of its ascensive power by an expenditure of the gas, he made great exertions with his mechanical machinery to reach a lower region. His efforts were successful, and he descended safely in the middle of a corn field, in the plain of Montmorency. All who witnessed the descent of so unexpected a visitor, ran eagerly to the spot; and the possessor of the field, exasperated at the injury which his crop had suffered by the crowd whom curiosity had collected around the aerial traveller, actually seized him, and demanded indemnification. M. Testu quietly submitted, and persuaded the angry peasant that, having lost his wings, he was deprived of the means of escape. A number of persons seized the ropes of the balloon, and, as it floated at the height of twenty feet from the ground, dragged it through the air towards the village. But as this extraordinary prisoner was conducted in triumphal procession, he perceived that his machine had acquired additional buoyant power by the loss of weight; he cut the cord, and instantly soared aloft, leaving the disappointed peasants in silent amazement fixed to the spot, and in a few minutes, dashing into a mass of clouds, eluded their astonished gaze. Here the temperature was at the freezing point; for he observed icy particles floating around, while the thunder rolled at a distance below him. As the day declined, the balloon began to descend, and a little before seven o'clock it had nearly reached the ground; but the discharge of a quantity of ballast enabled it to regain its ascensive power, and in twelve minutes it was at an elevation of 2400 feet, when the thermometer indicated a temperature of 66°. The blast of a horn here attracted his attention; and seeing a party of huntsmen keenly engaged in the chace, he allowed some gas to escape, and about eight o'clock descended towards the place. Having resigned his wings as a useless encumbrance, and collected some stones for ballast, this enterprising adventurer ascended a third time, and was soon involved in a thick mass of clouds loaded with electric matter. The thermometer fell to 25°; but when he reached an elevation of 3000 feet, it rose to 66°. From this lofty station he beheld, between nine and ten o'clock, the sun sinking below the western horizon, and soon after the shades of night closed around. Shrouded in darkness, he was wafted about for the space of three hours in the gloomy region of the gathering storm. All the terrors which surrounded him, the lightning's flash, and the roar of the thunder, accompanied with copious showers of sleet and snow, did not for a moment damp his courage, or induce him to abandon his perilous situation:

> Unusual darkness broods; and growing, gains
> The full possession of the sky, surcharg'd
> With wrathful vapour, from the secret beds,
> Where sleep the mineral generations, drawn.
> Thence nitre, sulphur, and the fiery spume
> Of fat bitumen, steaming on the day,
> With various tinctur'd trains of latent flame,
> Pollute the sky, and, in yon baleful cloud,
> A reddening gloom, a magazine of fate,
> Ferment: till, by the touch ethereal rous'd,
> The dash of clouds, or irritating war
> Of fighting winds,————————
> They furious spring. THOMSON.

By means of an artificial light which he struck, he observed that the thermometer had sunk to 25°. The different kinds of electricity were indicated by a sharp iron point fixed on the car; a luminous spot sometimes rested on the point, denoting the electricity to be negative; and sometimes a pencil of rays, or stream of light, seemed to issue from it, marking its character to be positive. A flag, embellished with ornaments in gold, frequently sparkled with fire, and was at last torn by the lightning; the clothes and apparatus of the aeronaut, when he returned to the earth, emitted a sulphureous smell, shewing that he had been immersed in a torrent of electric matter; and, during the storm, the balloon seemed to be agitated with a kind of undulatory motion, in a perpendicular direction, arising, it might be supposed, from the sudden collision of adverse clouds.

At length this tremendous scene of awful sublimity closed; the "war of elements" ceased; the vapours dispersed, and the stars appeared:

> As from the face of heaven the shattered clouds
> Tumultuous rove, th' interminable sky
> Sublimer swells, and o'er the world expands
> A purer azure. THOMSON.

Having escaped the dangers of the storm, the intrepid voyager began to feel the cravings of hunger, and now indulged in a solitary repast. Between two and three o'clock, the ruddy streaks of light in the east announced the approach of day. A little before four he contemplated from his lofty station the rising of the sun; and his ballast being exhausted, he retreated from the airy regions, which he had occupied for twelve hours: he descended in safety near the village of Campremi, 70 miles distant from Paris.

Curious Incident.—Among the numerous aerial excursions performed by Blanchard, by which, it is said, that enterprising voyager amassed a considerable fortune, his ascent from Strasburgh, in August 1787, was attended by a curious incident. In this voyage, an experiment with the parachute was proposed, and for this purpose he took a dog with him. When he had attained an elevation of 6000 feet, the parachute, with the dog in a basket suspended from it, was detached from the balloon. Soon after its separation it was carried upwards by a whirlwind, and disappeared among the clouds. Some-

Aerostation. time afterwards Blanchard fell in with the parachute, still floating in the air, and the dog, in hopes of rejoining his master, began to express his satisfaction by barking; but when the aeronaut attempted to lay hold of it, a sudden gust of wind carried it far beyond his reach. Blanchard continued his voyage, and having passed over the city of Zell, descended safely to the earth; but it was not till after the lapse of twelve minutes from the time of his descent, that the dog and parachute reached the ground.

Garnerin's aerial voyages.—M. Garnerin, whose aerostatic exhibitions, whether in number or perilous adventures, have been exceeded by none, undertook an aerial excursion from Paris in October 1797, for the purpose of descending with a parachute detached from the balloon. The parachute, half expanded, was placed between the car and balloon, and formed a kind of canopy. When he attained an elevation of 2000 feet, the parachute was separated along with the aeronaut: its descent was slow and steady, while it gradually unfolded; but when it had reached its utmost expansion, it assumed an oscillating, and somewhat of a circular motion, during which M. Garnerin was not altogether free from serious apprehension of being thrown out of the car. As it approached the earth, the motion became more steady and vertical, and he at last descended in safety.

The same aeronaut visited England in 1802; and on 28th June of that year, accompanied by an English gentleman, ascended with a balloon of 20 feet diameter, from Ranelagh Gardens. They passed over London, rose to the heighth of 10,000 feet, and having traversed the space of 60 miles from the place of ascent, they alighted on a common near Colchester, having sustained some injury from the violence of the wind. The weather during this voyage was unsettled and stormy: in their ascent the adventurers passed through a mass of dense black clouds, where the thermometer sunk 15 degrees lower than at the surface of the earth. When they attained a greater elevation, the temperature became perceptibly milder; and in their descent through a similar cloudy region, the balloon was much agitated and tossed about by conflicting currents of air.

Accompanied by another person, M. Garnerin encountered another heavy gale, in an aerial excursion on the 4th of the following July. In this voyage he rose to the heighth of nearly 8000 feet in the space of fifteen minutes; and the balloon in its descent, at the distance of nine miles, came down with such velocity, that when it struck the earth it rebounded nearly 200 feet above the surface.

In the month of September of the same year, this enterprising adventurer ascended from London about six o'clock in the afternoon, during clear and serene weather, for the purpose of exhibiting his experiment of a descent with the parachute. When he had reached an elevation of about 8000 feet in the space of eight minutes, the parachute was detached, and the circumstances which attended his progress downwards were nearly similar to those already related in a former experiment. For half a minute the descent was extremely rapid, but when the parachute was fully expanded, the motion became gentle and slower. Soon after, the oscillation commencing, increased to such a degree as to render his situation for some time most perilous; but as it approached the earth it descended with a more steady motion, and he at last alighted without sustaining any injury. Aerostation.

Zambeccari's voyage.—Count Zambeccari, who exhibited the first balloon in England, undertook a perilous aerial excursion from Bologna, in October 1803. The companions of his voyage were Dr Grassetti and Signor Andreoli. The preparations were not completed before midnight; and although the aeronauts expressed a wish to delay their ascent till next morning, the outrageous clamours of the disappointed spectators counteracted their intention, and obliged them to proceed on their voyage. The balloon rose with great rapidity, and very soon floated in a region where the cold was so intense that the Count and the Doctor were overpowered, and fell into a profound sleep. Between two and three o'clock the balloon began to descend, and Signor Andreoli, who had resisted the lethargic propensity, seeing the threatened danger, roused his unconscious companions, which he had scarcely accomplished when they were precipitated into the sea. To extricate themselves the whole of their ballast, and every thing that could be spared, were instantly discharged; and the machine, thus lightened, again rose into the atmosphere, and carried them through a mass of clouds, where the cold condensed the vapour, and covered their clothes with hoar-frost. Half an hour only elapsed, when the balloon descending, was driven by a severe squall towards the coast of Istria, and almost across the Adriatic sea. The ascensive power of the machine was now so much exhausted, that they remained on the surface of the sea for nearly five hours, with little hope of being rescued from a watery grave. But at eight o'clock in the morning, when at the distance of twenty miles from the coast, the crew of a vessel, perceiving their perilous situation, with considerable exertion took them on board.

Another aerial voyage from Bologna, attended with still more formidable dangers, was undertaken by Count Zambeccari and Signor Andreoli, in the month of August in the following year. The ascent took place at ten o'clock in the forenoon; in three hours afterwards, when the voyagers were six miles distant from Bologna, they attempted to descend; but the anchor being entangled in a tree, deranged their apparatus, and overturned a spirit of wine lamp in the car; the spirit was set on fire, and the flames communicating to a large quantity of the same spirit in another vessel, spread to the clothes of the adventurers, who were instantly in a blaze, and threatened with immediate destruction. The Count was fortunate in extinguishing the flames; his companion retreated from the car, by sliding down to the tree by the anchor rope; and the balloon lightened, rapidly mounted into the air, and was soon lost in the clouds. Driven by the wind towards the Adriatic, the balloon descended to the sea, twenty-five miles from the shore, and the half-burnt car sunk into the water, while the aeronaut seized the ropes of the balloon, and secured himself by fastening one of them round his body. A number of fishing boats, whose crews had descried the balloon, approached; but some of them, struck with so unusual a sight, took it for a monster of the deep, and fled for safety; others, with more courage and humanity, exerted themselves, and succeeded in delivering the sinking adventurer from his perilous situation, after he had been four hours in the water.

Robertson's voyage.—On the 30th June 1803, Professors Robertson and Sacharoff ascended from Petersburgh with a balloon of thirty feet in diameter. The weight of the whole machine, including the travellers, exceeded 700 pounds. The balloon was launched about seven o'clock in the evening, mounted slowly, and passing over the course of the Neva, began to descend, when, on the discharge of a quantity of ballast, it rose again. In this excursion, a kind of log, constructed of two sheets of thin paper, suspended by a thread, was employed for the purpose of observing the sudden rising and falling of the balloon, with more precision than is indicated by the barometer; and, to view objects on the surface of the earth, a telescope was fitted in the bottom of the car. During a calm, which continued for a short time, the motion of the balloon was altogether imperceptible; but several times it assumed a rotatory motion. As this aerial excursion was projected for scientific purposes, the adventurers intended to prolong it through the night; but being uncertain to what point they were now carried, and seeing the whole of their ballast expended, they were compelled to return to the earth; and before eleven o'clock, after being nearly four hours in the air, they alighted safely, at the distance of forty miles from Petersburgh.

Voyage of Gay-Lussac, &c.—With a similar end in view, M. M. Gay-Lussac and Biot, two French naturalists, ascended from Paris in August 1804. They were furnished with instruments for observing the temperature, pressure, and moisture of the air. They first passed through a region of clouds composed of light fogs, in which the hygrometer indicated a slight degree of humidity; but reaching a greater elevation, the air became drier; and when they looked downwards, the floating vapours presented the same blueish tint as when they are seen from the earth. In the course of this voyage, as had been observed by others, the balloon occasionally assumed a rotatory motion, differing in the direction. After ascending to the height of more than 13,000 feet, they returned in safety to the earth, nearly fifty miles distant from Paris.

In September following, M. Gay-Lussac ascended alone; and when he had reached the height of 22,965 feet, he beheld, with astonishment, a mass of clouds floating at a still greater elevation. In his former expedition, the clouds were not higher than 5000 feet. He now mounted to a greater height, and at one time was not less than 23,100 feet above the surface of the earth. He alighted safely twenty miles from Rouen.

Fatal accident.—It is not a little remarkable, that, among so many aerial excursions, few serious accidents have happened to the aeronauts. The voyage now to be noticed, is one which terminated fatally. In April 1806, M. Mosment, who was no untried adventurer in the regions of the air, ascended from the city of Lisle, at 12 o'clock, mid-day, in presence of a vast concourse of spectators, whose tumultuous acclamations accompanied his progress, while he waved a splendid banner, decorated with the insignia of the emperor of France, in token, as it might seem, of the abject subjugation of those who witnessed the exhibition, and of the uncontrouled dominion of that ambitious power. He mounted with great rapidity, and in a short time disappeared from the sight of the populace. An animal which he carried with him was sent down with a parachute, and reached the ground in safety; but about an hour after his ascent, something was seen floating in the air, and moving slowly towards the earth; and when it came down, it was immediately recognised to be the flag of the aeronaut. This excited very alarming apprehensions for the safety of M. Mosment himself; and the discovery of his lifeless body, covered with blood, in one of the ditches of Lisle, afforded a melancholy proof that they were not groundless. It cannot be certainly known to what this unfortunate accident was owing; but it was conjectured, that the car being very shallow, he might have lost his balance in detaching the parachute for the descent of the animal, or in performing some other necessary manœuvre in the voyage. The balloon was wafted more than 70 miles from Lisle, and came to the ground the same day. A small portion of bread, a bit of flesh meat, and an unloaded pistol, were the only things found in the car.

Nocturnal excursions.—The French, whose curiosity was probably in some degree satiated with the repetition of aerial voyages in the ordinary form, now sought gratification in varying the exhibition; and the resources of that ingenious people were not exhausted in diversifying this interesting spectacle. The daring spirit of M. Garnerin fitted him for undertaking a nocturnal aerial excursion; and the first voyage of this description which he attempted took place on the 4th of August 1807, which might be regarded as an aerostatic festival, in honour of the treaty of peace which had been concluded between France and Russia; and in compliment to the latter power, he ascended under its flag. The balloon was splendidly illuminated by twenty lamps, which were suspended at least fourteen feet below it, that the danger of communication with the inflammable air might be avoided; and to obtain still greater security, tubes were so arranged for its escape, that it might pass off in an opposite direction from the burning bodies. At eleven o'clock at night the balloon was launched into the air from Tivoli near Paris, and soon rose to such a height, that rockets sent up from the same place seemed to the voyager to be a very short way above the earth, and the lofty buildings of Paris, with its numerous lamps, appeared to present only a plain surface marked with shining spots. In forty minutes he had attained an elevation of more than 13,000 feet, when the balloon was so much distended, that it became necessary to permit part of the gas to escape. At midnight he had descended to a region not higher than 3600 feet above the earth, when the barking of dogs was distinctly heard; and in one part of the voyage, meteors were seen darting from one quarter of the heavens to another. Between three and four o'clock, the sun, emerging from a sea of clouds, rose in radiant splendour, and the influence of his rays expanding the included air, the balloon mounted rapidly to the height of 15,000 feet, a region of intense cold; and having pursued his devious course in the atmosphere for more than seven hours, the voyager terminated his expedition at Loges, 140 miles from Paris.

A similar enterprise had nearly proved fatal to the same intrepid voyager. In this excursion, M. Garnerin had agreed to admit a companion to share his adventures; but the lowering aspect of the heavens indicating a storm, induced him to encounter its dangers alone, and to refuse compliance with the urgent solicitations of his disappointed friend. On the 21st of the following September, at ten o'clock at night, he ascended from Tivoli, and darted upwards with astonishing rapidity, to a great elevation, where the expansive force of the included air became so great as to threaten an immediate rupture of the balloon; and as the eager curiosity and pressure of the crowd had interrupted the aeronaut in the regulation of his apparatus for the escape of the gas without risk of communication with the burning lamps, he was compelled, in this perilous extremity, to make an opening two feet in diameter with one hand, while he extinguished with the other all the lamps within his reach. The storm increasing, the machine was driven upwards at one time with great violence, and at another sunk suddenly towards the earth. Having expended the whole of his ballast to recover the power of ascent, and the valve for the escape of the gas being rendered useless, he was altogether at the mercy of the tempest. Now tossed about in the midst of the boisterous elements,—now dashed to the ground, and rebounding to a great height in the air,—and now driven with great fury against the mountains,—the unfortunate aeronaut was for some time thrown into a state of insensibility. When he recovered his senses, he had reached Mont Tonnerre, while the thunder-storm continued with all its violence; his anchor was entangled in a tree; and, after a most perilous voyage of more than seven hours duration, he alighted on the ground 300 miles distant from Paris.

Mr Sadler ascends from Bristol.—On Monday the 24th September 1810, Mr Sadler, accompanied by Mr Clayfield of Bristol, performed his 16th aerial voyage. They ascended from that place at twenty minutes past one o'clock. The wind blew fresh from the N.E. The machine rose majestically; and although the ascent was extremely rapid, the aeronauts were not sensible of any motion. When at the height of half a mile, the balloon was involved in a thick black cloud, which concealed Bristol and its vicinity from their view. Soaring rapidly aloft, they soon passed through the cloud, and, looking downwards, saw in its centre the shadow of the balloon, surrounded by a beautiful halo or circular rainbow. The balloon still continued to ascend, and soon entered a second cloud. Having passed over the river near Redcliff, a parachute, with a cat in a basket, was detached. For some time the descent was very rapid; but when the parachute had reached its full expansion, it assumed a slow and graceful motion.

Leaving behind the Somersetshire coast, the voyagers were carried over the Channel; and when about mid-channel the valve was opened; soon after which they descended so low as to hear the shouts of the people and the sound of the breakers between Barry and Scilly islands. But as the current of air now impelled them towards the sea, and they were apprehensive of not being able to reach the main land, a quantity of ballast was thrown out. The balloon still continuing to descend towards the sea, a quantity of sand was shaken from a bag; but as this produced no effect in retarding the descent, several bags were thrown out, when the motion was instantaneously reversed, and in its ascent the balloon came in contact with the sand first projected, which fell in a copious shower on the car. The occurrence of this curious incident shews the great velocity of the balloon's descending motion, which far outstripped the descent of the sand, and having acquired an ascensive power by the discharge of ballast, met the sand proceeding towards the earth, comparatively with a slow motion. The balloon continued its ascent till 40 minutes past three o'clock, when it approached the Devonshire coast, the whole of which, with Lundy island, and part of Cornwall, appeared before them; on the right was seen St George's channel, with part of the Irish and Welsh coasts; and the Flat and Steep Holmes, and the coast of Monmouth, were observed behind.

It was now past four o'clock, and the aeronauts were anxious to reach the land. For this purpose they threw out almost every thing in their possession,—all their instruments,—a great coat,—a grappling-iron,—and even part of the interior covering of the car; but the dissipation of the gas was so great, that they saw the machine could not rise to a sufficient height to surmount the lofty cliffs on the coast. The balloon descending rapidly towards the sea, the voyagers secured themselves with life-preservers; and in a few minutes afterwards the car dashed violently into the water, at the distance of four miles from land. The car nearly filled with water, was dragged by the balloon, which was impelled along the surface of the sea by the wind, and was drifting fast from the shore. In this perilous situation they continued for an hour, when a well-manned boat, dispatched by some gentlemen from the cliffs of Lymouth, approached, and received them on board; but two hours elapsed before they could exhaust and secure the balloon. Fatigued with the toils and dangers of the aquatic part of their excursion, the voyagers did not reach the pier of Lymouth till nine o'clock at night. They were hailed with acclamation in every town through which they passed on their way to Bristol, where they arrived on Wednesday, and were greeted with the most joyous welcome which the warmth of friendship could express.

Mr Sadler's ascent from Dublin.—The same enterprising aeronaut undertook an excursion from Dublin, for the purpose of crossing the Irish channel. The balloon was of a spherical form, 55 feet in diameter, and was only two-thirds filled, to allow space for the expansion of the included gas in the higher and rarer regions of the air, and the car was loaded with 1100 pounds of ballast. He ascended from Belvidere-house, in the vicinity of Dublin, a little before one o'clock, afternoon, on the 1st of October 1812, in presence of the ladies of the vice-regal court, a great assemblage of beauty and fashion, and an immense concourse of spectators. When he launched into the atmosphere, the barometer stood at 29° 95, and the thermometer at 63°; but in eighteen minutes he had attained such an elevation, that the barometer sunk to 23°, and the thermometer to 49°. He was now approaching to the regions superincumbent to the Irish sea. The balloon was greatly distended, and the voyager was in no small degree alarmed, when he perceived a rent in the silk, where the tube through which the valve cord passes is united with the balloon, and a copious stream of gas issuing from it. The distension of the balloon had given it more of a globular form, so that the lower part of it was beyond his reach, even when he stood on the hoop to which the car was suspended. With some difficulty he made a ladder of ropes, by tying cross pieces to the net-cords, and, with great hazard, mounted this temporary structure, by placing a foot on each side to preserve his balance, and succeeded in closing the orifice, by passing his neckcloth several times round the tube and contiguous parts of the silk. A giddiness, produced by the stream of gas rushing in his face, while engaged in this necessary operation, rendered his situation still more perilous; but although he was nearly overpowered, and the effects of it continued for some time, he regained the car without accident. The gas, as it issued from the opening, felt warm; and when examined by the thermometer, which in the air stood at 42°, it raised it to 71°, indicating a difference of 29 degrees.

The balloon, still continuing to ascend, had reached a current of air from the N.E., but the valve being opened, it sunk, and regained the current from the S.W.; and being carried obliquely across the channel, about two o'clock the voyager had a distant view of the Isle of Man; in the short space of eleven minutes, he saw distinctly the towns, villages, and enclosures; and in twenty minutes more, floated above its south-eastern shore. This course promised a speedy arrival on the Cumberland coast; but as the aeronaut was anxious to terminate his excursion in Lancashire, he discharged some ballast, and again mounted into the north-east current. At four o'clock he was over the island of Anglesea, when the barometer fell nearly to 15°, and the thermometer to 31°. He was now more than three miles above the surface of the earth.

Disappointed of a favourable current of air to enable him to reach the land, and observing the approach of evening, Mr Sadler determined to avail himself of the assistance of several vessels in the channel. He opened the valve, and in a few minutes was precipitated into the sea; but how greatly was he mortified to find, that the vessels, not more than a mile distant, and from which so conspicuous an object could not be unnoticed, continued their course, and left him to seek elsewhere more friendly aid. He threw out some ballast, reascended to a considerable height, and from his lofty station regained another prospect of the orb of day in full splendour, while to the world below that luminary had sunk below the horizon, and with a few reflected rays had formed over sea and land a twilight scene. But this temporary accession to the day was nearly spent; the voyager seeing another vessel from whose signals kinder intentions might be expected, pulled the valve and descended to the sea. But the force of the wind impelled the floating machine with considerable velocity along the surface of the water; and the grappling iron, with great part of his clothes which he had stripped off, being sunk, to retard its progress till the vessel should reach it, and still proving insufficient, the valve was opened to diminish its buoyant power by the escape of a quantity of gas, when instantly the loaded car, no longer supported, sunk, and left the aeronaut to secure himself, by seizing the cane-hoop and afterwards the netting of the balloon. In this perilous situation he was for sometime dragged through the water, and frequently immersed under its surface, till at last the vessel approached, and no other resource being left to save the exhausted and sinking adventurer, the bowsprit was run through the balloon, a rope was thrown to him, he was taken on board nearly in a state of insensibility, and the aerostatic apparatus being secured, he arrived at Liverpool next morning.

When Mr Sadler descended the second time, and the moment that the car touched the water, a flock of sea fowl crowded around the balloon, and eagerly pursued the floating machine as it was wafted along. He supposed that they were attracted by the fragments of bread which were scattered on the surface of the sea; and in this he was soon confirmed, by their boldly rushing upon him in a body, and voraciously devouring what remained of his stock of provisions. The description of these birds corresponds with the species known by the sailors under the name of *Mother Carey's chickens*, the *procellaria pelagica, Lin.* or stormy petrel.

This aerial excursion affords a fine illustration of the opposite currents of air in different regions of the atmosphere. In the higher region, the direction of the current was from the south-west; but in a less elevated region a north-east current prevailed steadily for several hours. The same fact is also exemplified in an aerial voyage performed by Mr Sadler, junior, in which he was accompanied by a lady, in July 1815. He ascended from Norwich, rose to a considerable height, was carried over the sea eighteen miles, discharged some ballast, by which he reached a greater elevation, and floating in a different current, retraced his course, and alighted safely not more than two miles distant from the place of ascent.

It would be easy to extend our narrative of the history of aerial navigation to a much greater length; but without variety of incident or novelty of observation, we should indulge in useless repetition, and contribute nothing to the instruction or amusement of the reader. We now proceed to treat briefly of the construction, management, and uses of aerostatic machines.

Construction of Balloons.—For the purpose of ex-

Aerostation.

hibiting the ascensive power of balloons, they may be constructed of thin paper, varnished with lintseed oil, when they are to be filled with hydrogen gas. But if they are to be distended with rarefied air, it has been recommended to impregnate the paper with a solution of alum, sal ammoniac, or some other salt, by which the danger of fire from the materials employed in sustaining the rarefaction of the air is greatly diminished. The paper is cut in the usual way, and pasted together at the edges. An opening is left at the lower end of the balloon, in proportion to its size, for admitting the rarefied air or the introduction of the matters by the combustion of which the heat is kept up. A small wire is passed round the orifice, and secured at its edges, to preserve the distension; and cross wires are placed within to support a light vessel, containing the spirit of wine, which is usually employed, or what answers better, a piece of sponge or a quantity of cotton thoroughly soaked with the same fluid. When the balloon is distended by bringing it near a fire, or holding a heated body under the aperture, the vapour of the spirit of wine from the sponge or cotton is set fire to; and when the included air is sufficiently rarefied, the machine makes an effort to ascend in proportion to its size and the rarefaction of the air. Balloons intended merely to illustrate the principle, should not be constructed of a smaller magnitude than two feet in diameter; but this depends on the weight of the covering employed; for if the weight of the covering should exceed the difference of weight between the included air and the same bulk of atmospheric air, the balloon will not rise.

Fire balloons of a large size, or such as are intended for aerial voyages, have been usually constructed of an oval form, or in the form of an inverted and truncated cone. This shape, it is supposed, allows the rarefied air to expand as it ascends from its natural tendency towards the top, while the colder air occupies the lower and narrower part. Balloons constructed on this principle, have been usually made of a large size. The covering is linen cloth, soaked in a solution of alum, to preclude as much as possible the danger of fire, and varnished to prevent the escape of the air. The aperture at the lower part, to admit the heated air, is recommended to be of a cylindrical form, to extend at some distance from the body of the balloon, and to be at least one third of its diameter, when it exceeds 50 feet. The fire-place for burning the fuel is placed within the tube, that the rarified air may ascend to sustain the expansion. The fuel usually employed was chopped straw, wool, loppings of vines, and other matters which yield a great deal of smoke. But as balloons of this nature have been superseded by those filled with hydrogen gas, it would be needless to enter more minutely into their description.

Balloons filled with hydrogen gas are generally of a globular form. The covering is a fine silk, called tiffany or lutestring, with a network interwoven in its texture, which gives it additional strength; and to add to the attractive appearance of the machine, it is sometimes composed of alternate stripes of different colours. To render the silk less permeable to the gas, it is carefully varnished. Different kinds of varnish have been recommended. A varnish of elastic gum, or caoutchouc, is, we believe, now generally employed; and is prepared by the following process. The caoutchouc, or Indian rubber, is cut into small pieces, and dissolved in five times its weight of spirits of turpentine. Several days are necessary to complete the solution; when this is effected, one ounce of it is added to eight ounces of drying lintseed oil; the mixture is boiled for a few minutes; it is then strained, and is fit for use. This is the method for preparing the elastic gum varnish which was adopted by Blanchard, who had great experience in the construction of aerostatic machines. The solution is applied warm, and with a flat brush, to the silk well stretched. One coat of varnish is found sometimes to answer; but if two are required, the first must be allowed to dry before the application of the second. It was usual to cover both sides of the silk with varnish. But it appears from the experience of the superintendants of the Aerostatic Institute in France, to be afterwards noticed, that balloons varnished only on the outside are the most durable; for the elastic gum varnish is corroded by the gas, and leaves the silk in a flabby state. The silk being varnished is cut into pieces or gores for forming the balloon, exactly in the same way as the paper for covering globes. The different pieces are cut larger than the pattern, that the edges may overlap; and they are united by passing a heated iron with an intervening fold of paper along them, which slightly melts the gum and makes the pieces adhere; and to give the joining greater strength and security, it is stitched with a thread along the seam.

To find the quantity of cloth required for the covering of a balloon of a spherical form, the square of the diameter is multiplied by the number 3.1416. Thus, in a balloon of thirty feet, the square of the diameter is 900, and this number multiplied by 3.1416, gives $2827\frac{1}{2}$ feet nearly for the superficies; and this last number being divided by 9, the quotient is 314, or the square yards in a balloon of that size. The weight of the whole covering is found by weighing one yard of the silk, and multiplying the number of yards employed by that weight. The capacity or solid contents of a balloon of a globular form is estimated by multiplying the cube of the diameter by the decimal .5236; as, in the balloon of 30 feet diameter, the cube is 27,000, and this multiplied by .5236 gives 14,137 cubic feet. The balloon with which Mr Sadler ascended from Dublin had a surface of 9503 square feet; and its solid contents amounted to 87,133 cubic feet.

To ascertain the ascensive power of a balloon, the difference of weight between the hydrogen gas and an equal bulk of atmospheric air must be calculated. The weight of a cubic foot of atmospheric air is estimated at one ounce and two-tenths nearly. The weight of a mass of atmospheric air equal in bulk to a balloon of 30 feet diameter, whose solid contents are 14,137 feet, amounts to 1060 pounds. The hydrogen gas with which balloons are filled, is about 6 times lighter than common air. This makes the weight of a balloon of 30 feet diameter filled with hydrogen gas, to be 176 pounds nearly; and if the yard of silk be estimated at one pound, the weight

Aerostation. of the covering is 314 pounds, the number of yards required for a balloon of this size. The weight of the covering and the included gas being subtracted from 1060 pounds, the weight of an equal bulk of atmospheric air, leaves 570 pounds as the power of ascent of such a balloon. In the same way the ascensive power of balloons of any other size may be calculated.

The balloon is furnished with a valve usually placed at the upper part of the sphere, but sometimes at its side. The valve presses on the orifice, of several inches in diameter, by means of a spring; and it is opened by pulling a cord which passes through the balloon and the silken tube to the car, to permit the gas to escape when necessary. The silken tube, of six or eight inches in diameter, receives the gas from the apparatus in which it is prepared, and conveys it to the balloon; and when the latter is sufficiently distended, the tube is secured with a ligature. A net made of the best materials, usually we understand of Italian hemp or of French cambric thread, to combine lightness and strength, is spread over the whole balloon, and the cords which terminate the net at the lower part are fastened to a light cane hoop. To this hoop the ropes by which the car is suspended are attached. The car, somewhat in the form of a boat, is made of wicker work, or some other light material, covered with well varnished leather. The splendid and costly car which Mr Sadler exhibited at Glasgow and Edinburgh in 1815, and in which it is said that aeronaut proposed to ascend at the coronation of the king of France, has a double covering of elastic gum, between which there is a stratum of included air, which gives it additional buoyancy; and from this construction it has the advantage of being a life-boat in case of falling into the water. The car is of sufficient magnitude commodiously to admit of two persons, besides the instruments for making observations, and the necessary ballast, which is commonly sand put up in small bags. When the aerial voyage is in the vicinity of the sea, the aeronaut provides himself with a life-preserver. A convenient form of this necessary apparatus, is a cylindrical hoop of thin copper, divided into air-tight cells, and so constructed as to fit the trunk of the body, under the arms, where it is attached.

Preparation of hydrogen gas.—The gas which is employed in filling balloons, is usually obtained from iron, sulphuric acid, and water. About 2000 pounds weight of the turnings or borings of cannon, and an equal weight of sulphuric acid, or the oil of vitriol of the shops, diluted with six times its weight of water, is supposed to yield a sufficient quantity of gas to fill a balloon of thirty feet in diameter. Lunardi had a very simple apparatus for preparing the gas. Two casks were sunk in the earth, to strengthen them, and preclude the risk of bursting. The iron turnings were put into the casks, and, to expose a greater surface to the action of the acid, they were separated into layers, by a quantity of straw interposed. The diluted acid was added; and the gas, as it arose, was directly conveyed to the balloon, without passing through water to cool it, or to separate the sulphurous acid, which, it is probable, was copiously evolved by the action of the vegetable matter during the process. This method was greatly improved, by having a number of casks communicating with a large one inverted over water, from which the gas, after passing through the water, is introduced into the balloon. In this way it is both cooled and purified from those substances which increase its specific gravity, or tend to corrode the silk. A quantity of quick-lime is mixed with the water for the same purpose. The number of casks and coolers is to be proportioned to the size of the balloon, or the time allowed for filling it; and it is found convenient to have the casks in which the ingredients are placed lined with tin-plate. The apparatus which Mr Sadler employed in procuring hydrogen gas for his ascent at Edinburgh in 1815, consisted of a leaden cistern inclosed in a wooden box, and covered with loose boards kept down with weights, to resist the expansive force of the gas. The cistern was about eighteen feet in length, three feet in breadth, and two in depth. A tin-plate tube, of seven or eight inches in diameter, conveyed the gas from the cistern to a cooler; and having passed through the water, it was conducted through a similar tube to a second cooler, from which it passed into the balloon. With this apparatus, a balloon of thirty-six feet in diameter was filled in two hours and a-half. It is scarcely necessary to add, that the balloon must be held down as the distension proceeds, to prevent its escape, as has happened in some cases, and that the compressed covering is introduced into the net before the filling commences.

The Aërostatic Institute, at Meudon in France, obtained the hydrogen gas from the decomposition of water, by means of red-hot iron. For this purpose, six or eight hollow iron cylinders are set in brickwork in a furnace. The projecting ends of the cylinders are stopped with strong iron covers, through which pass metal tubes for introducing the water at one end, and conveying the gas, as it is formed, from the other. The cylinders are partly filled with coarse iron filings; and when they are sufficiently heated, boiling water is admitted through a valve, and as it comes in contact with the red-hot iron, it is decomposed; the oxygen combining with the iron, and the hydrogen passing off by the other end, is first conveyed through water in which some alkaline matter is dissolved, and then into the balloon in a cool and purified state. By this process, which appears to possess the advantage of being economical, a balloon of thirty feet in diameter is filled in eight hours.

To allow space for the expansion of the included gas in the higher and rarer regions of the atmosphere, the balloon should not be filled more than five-sixths, or perhaps not more than three-fourths, according to the elevation which the aeronaut proposes to reach.

Management of Balloons.—In conducting a balloon, the whole art of the aeronaut is nearly limited to its ascent or descent in the atmosphere; and here he has complete power over his machine; for, by pulling the valve, and permitting a quantity of gas to escape, its buoyancy is diminished, and it descends, and by discharging ballast the machine is lightened, and its ascensive power increased, so that it attains a greater elevation. The course of a Aerostation.

balloon in the air is exactly the same as the current of air in which it floats. No attempt yet made has succeeded in giving it a different direction. The application of wings, oars, and rudders, has been tried in vain; no sensible effect is produced, except a rotatory motion, which, Mr Sadler informs us, can be communicated merely by waving the flag.

Parachute.—The dangers of aerial navigation, which, it ought to be observed, are far less formidable than might at first be expected, and the fatal accidents which have befallen some aerial travellers have probably suggested the invention of the parachute, by which the aeronaut might descend safely to the earth, when his situation with the balloon became dangerous. The construction of the parachute is similar to that of an umbrella. The parachute which M. Garnerin employed, when he came down from a balloon at London, in 1802, consisted of thirty-two pieces of canvas; and the whole, when united and expanded, presented a diameter of twenty-three feet. Each gore, or piece of canvas, was fastened with a cord to a round piece of wood, ten inches in diameter, and perforated in the centre; and between four and five feet from the top of the canvas, a wooden hoop was secured, by small cords from each seam. From the edges of the parachute a number of ropes, about thirty feet in length, passed downward, and were united at their extremities; and the circular basket for the aeronaut was suspended by shorter ropes proceeding from the common joining. With a parachute of this description, M. Garnerin descended near London, in September 1802, from an elevation of 8000 feet. The same enterprising aeronaut has frequently repeated the experiment; and in summer 1815, Madame Garnerin, who has been his companion in many aerial excursions, boldly attempted, and successfully achieved, the same daring exploit at Paris.

In most cases the adventurers have reached the ground in safety by this mode of conveyance. But parachutes of this construction are subject to the serious inconvenience of an oscillatory motion in one part of their descent. This motion, which is not altogether free from danger to the aeronaut, commences when the full expansion of the parachute takes place, and is no doubt owing to the air compressed in the concavity, and escaping unequally under the edges. To obviate this inconvenience and danger, a perforation of two or three feet in diameter, in the centre of the parachute, to allow the compressed air, before it accumulates, to escape, has been proposed. It has been suggested also, that a parachute constructed in a form exactly the reverse of that now described, namely, by presenting the convex surface downwards, would descend with an undeviating vertical motion. This suggestion, first started, we believe, by Sir George Cayley, who has published some ingenious speculations on aerial navigation, *(Nichol. Jour. vol.* 24.*)* is confirmed by experiments on a small scale. Mr Kerr, of Edinburgh, has favoured us with a communication, in which a still more plausible improvement is proposed, and has been also submitted to the test of experiment. The parachute, according to Mr Kerr's construction, is in the form of an inverted cone, from the point of which proceed the ropes by which the basket for the aeronaut is suspended. The edge of the parachute is turned downward, forming a circular concavity. By this construction there can be no accumulation of air in the central parts of the parachute; and the compression which takes place in the concavity near the outer rim, promises to give it greater stability in its descent.

Uses of aerial navigation.—The advantages of navigating the air with balloons, if we except the additions made to the stock of meteorological knowledge, are far less considerable than the first discovery of this wonderful art seemed to hold out. The most material facts which have been observed in the upper regions of the atmosphere, are already noticed in the detail of particular voyages in the preceding narrative. But although the utility of this art has been hitherto extremely circumscribed, and its improvement has been long stationary, it would be rash to conclude that some fortunate discovery may not render it one day a valuable acquisition to science, and highly beneficial to mankind.

It has been proposed to employ balloons in making surveys of countries, a purpose for which they are surely but ill suited, on account of their instability. It has been also suggested, that they might be successfully employed in communicating signals. The first actual application of this art was made by Coutel, who, accompanied by an adjutant and a general, ascended with a balloon on the 26th of June 1794, to reconnoitre the hostile armies at the battle of Fleurus. Twice on the same day he mounted to the height of 440 yards, to observe the position and manœuvres of the enemy; and each time he remained four hours in the air, and, by means of signals, held a correspondence with General Jourdan, the French commander. When the balloon first arose, the enemy opened the fire of a battery against it, and one ball passed between it and the car. In the subsequent discharges the aeronauts had reached such an elevation as to be beyond the range of cannon shot, and saw the balls flying beneath them. Arrived at their intended height, it is added, the observers, remote from danger, and undisturbed, viewed all the evolutions of the enemy, and, from the peaceful regions of the air, commanded a distinct and comprehensive prospect of two formidable armies engaged in the work of death.

An aerostatic telegraph has been constructed by the French. It consists of eight cylinders of varnished black silk, stretched on hoops, each three feet in diameter, and of a proportionate length. These moveable cylinders are suspended from the bottom of the car, connected together with cords, and hanging one above another at the distance of four feet. By means of cords passing through the bottom of the car, the observers direct the cylinders, give them different positions at pleasure, and thus conduct their telegraphic correspondence from the regions of the atmosphere. M. Conté, from whose ingenuity this invention derives its origin, has projected another kind of aerostatic telegraph, with which a person on the ground may carry on an aerial correspondence, by means of cords, and this may be managed with the apparatus suspended to a balloon of ten or twelve feet in diameter.

Aerostation.

The only public establishment for the improvement of aerial navigation, was the Aerostatic Institute, founded by the committee of public safety, during the period of the French republic. This establishment, which was fixed at Meudon, not far from Paris, was placed under the superintendance of Guyton Morveau, the celebrated chemist, and under the immediate direction of M. Conté, already alluded to as the inventor of the aerial telegraph. The corps of aeronauts, who were destined to serve in the armies of the republic, was composed of fifty young men. With this establishment was connected a camp for the exercise of artillery; and all its affairs were conducted with the utmost precaution, and the most profound secrecy. The doors were kept shut not only against all foreigners, but also against the public, whom curiosity might attract to witness the methods of instruction and training. During the summer season, the pupils were daily engaged in the performance of aerostatic exercises, as well as in the acquisition of those branches of natural philosophy which are closely allied with the objects of the institution. The exercising balloon was of a spherical form, and thirty-two feet in diameter. The upper half was covered with a linen case to protect it from the rain. The car and other apparatus were arranged and secured in the usual way. The balloon was kept constantly full and ready for ascent, and, being held down by means of ropes, preserved its buoyant station in the atmosphere. When the weather was favourable, the aeronautic exercises commenced; a colonel mounted with one of the pupils, and the machine was allowed to rise to the height of 160 or 240 yards. The pupils were formed into divisions for the purpose of regulating the ascent of the balloon in the air, by means of three principal ropes proceeding from the net and branching into others. In directing these manœuvres the aid of a capstan was employed; for when the balloon was recently filled, and had lost nothing of its buoyant power, the strength of twenty persons was requisite to hold it, and then it was capable of supporting 800 pounds; and even at the end of two months, the ascensive power was so little exhausted, that it was capable of rising to the same height in the air with two persons, all their instruments, and a considerable quantity of ballast.

The French nation, whose mad career of military enterprise had just commenced, seem to have cherished the most ardent hopes of the advantages to be derived from this establishment in accomplishing their wild schemes of ambition; but these hopes were never realized: the institution was of short duration; it has been entirely abandoned, and it does not appear that it has bequeathed any benefit to the art of aerial navigation. No similar institution has ever arisen under the fostering care of public patronage. The improvement of the art is at present exclusively confined to the fortuitous observations of aeronautic adventurers, whose chief object, it is most natural to suppose, is immediate emolument; and although their efforts, in exhibiting the gratifying spectacle of an aerial voyage, have been in general pretty liberally rewarded, yet the great expence of such experiments precludes their frequent repetition, and consequently narrows the bounds of useful discovery by which its progress might be advanced. The art of aerostation may be regarded as yet in its infancy; the wonder and astonishment excited by an aerial voyage have scarcely subsided; and the contemplation of the long intervening period from the rude essay of floating down the stream on an unformed mass of wood, to the high degree of perfection which the art of navigating the trackless ocean has attained, encourages the hope, that the resources of ingenuity in the improvement of sailing in the atmosphere are far from being exhausted. It is true, the fluid in which the airy vehicle floats and the moving power are the same; but still, the difficulty of directing the machine may be surmounted by some happy contrivance, some fortunate application of the very means at this moment within the power of man.

Explanation of Plate I.

Fig. 1. represents the rarefied air balloon, 76 feet in height, and 45 feet wide, with which Pilatre de Rozier and the Marquis D'Arlandes ascended from Paris, and performed the first aerial voyage.

Fig. 2. M. Blanchard's balloon, furnished with the apparatus of wings, or oars, for the purpose of steering.

Fig. 3. The balloon of Mr Sadler, junior, with a view of the buildings of the College of Edinburgh, from which place he ascended in November 1815.

Æruscatores.

ÆRUSCATORES, a name applied by the ancients to strolling beggars, or gypsies, who supported themselves by fortune-telling. A similar denomination was given to the collectors of the revenue, and also to the priests of Cybele, the mother of the gods in heathen mythology, who went about the streets soliciting alms; a practice which seems to resemble that of the mendicant orders of certain establishments connected with religion in modern times, and from which, perhaps, it may have derived its origin.

Æschines.

ÆSCHINES, a celebrated Grecian orator, and the formidable rival of Demosthenes, was born at Athens, 327 years before the Christian era. His own account traces his descent from an illustrious family; while that of Demosthenes, perhaps not strictly impartial, represents him as the son of a courtezan, and at one period of his life a humble performer on the stage. The talents and acquirements of Æschines, which raised him to the rank of competitor with the great Grecian orator, could not be of an ordinary kind; and the rivalship which subsisted between them, and which at last burst out into violent and open hostility, forms the most memorable event in the life of Æschines which has been transmitted to posterity. The two orators had become the leaders of opposite parties; and urged by mutual jealousy and animosity, were probably not slow in finding matter of accusation against each other. Demosthenes charged Æschines with taking bribes while employed in an embassy. Æschines indirectly retorted the charge, and accused Ctesiphon, the friend of Demosthenes, for proposing an illegal decree to

BALLOONS

Fig. 1. MONTGOLFIER'S

Fig. 2. BLANCHARD'S

Fig. 3. SADLER'S

Engraved by W. Miller

confer a golden crown on the latter as a mark of public approbation. The matter came before the judges, and a numerous assembly of citizens. The orators exerted all the powers of eloquence; and on this occasion Demosthenes pronounced his most splendid oration, which derives its title,—*Concerning the Crown*,—from its subject. Æschines was condemned to exile; the resentment of his opponent melted into kindness: Demosthenes presented him with a sum of money, which produced an expression of regret to leave a country in which he found so generous an enemy, that he despaired of ever meeting such a friend. Æschines taught eloquence at Rhodes, and afterwards removed to Samos, where he died, in the seventy-fifth year of his age. Three only of his orations are extant. The eloquence of Æschines is acknowledged to be energetic; but it is diffuse, loaded with ornament, and more suited to please than to rouse the passions.

ÆSCHYLUS, a Greek tragic poet, was a native of Athens; but the time of his birth is variously fixed by different authors, in the sixty-third, the sixty-fifth, and the seventieth Olympiad. The father and two brothers of Æschylus acquired great renown in the famous battle of Marathon, and the equally celebrated naval engagement of Salamis. The poet, also, it is said, shared the glory of these splendid victories; but the younger brother, Aminias, peculiarly signalised himself by deeds of heroism. To this brother Æschylus was indebted for his life; for being charged with impiety, he was condemned to be stoned to death. At the moment when the sentence was to be executed, Aminias came forward, threw open his cloak, and presenting his arm without a hand, which he had lost in defence of his country, roused his fellow-citizens to a recollection of his own bravery, and obtained a remission of the punishment, and pardon for his brother.

Æschylus is to be regarded as one of the first reformers of the stage: He introduced the dialogue between two persons, as well as the mask and buskin, with appropriate dresses for the actors; and he arranged the chorus, which formerly held a chief place, in a subordinate station in the action represented. Of a great number of tragedies composed by Æshylus, seven only are known to be extant. They have been universally admired in all ages. They are distinguished by a simple and natural plot, grandeur and sublimity of thought, and bold and vigorous language, abounding in striking and uncommon metaphors. Æschylus withdrew from his native country towards the close of his life, in consequence, it is said, of the indignity to which the prosecution had exposed him, or of the rising fame of Sophocles, another tragic poet, whose works had acquired great popularity. He retired to Syracuse; and it is recorded that he was killed in the sixty-ninth year of his age, as he was walking in the fields, by the strange accident of a tortoise dropped from the air by an eagle, and falling on his head. The Sicilians paid great respect to his memory; he was honoured with a pompous funeral, and theatrical entertainments were exhibited at his tomb.

ÆSCHYNOMENE, or Bastard Sensitive Plant, a genus of plants belonging to the class Diadelphia.

ÆSCULAPIUS, according to the heathen mythology, was the god of physic, and the son of Apollo and the nymph Coronis, received his education from the centaur Chiron, and became so skilful and celebrated for the cure of diseases, that Pluto, alarmed that his domain should be deprived of its population, complained to Jupiter, who slew Æsculapius with a thunderbolt, and banished him to the infernal regions. Apollo revenged the death of his son, by destroying with his arrows the Cyclops who forged the thunderbolt. The fabulous records of antiquity describe three deities of the same name, as the reputed authors of useful inventions or valuable discoveries in medicine and surgery; or perhaps the same personage is referred to under a different form and character. Æsculapius was worshipped under the form of a serpent, at Epidaurus, where his most celebrated temple was erected. This famous shrine contained a statue of the god in gold and ivory, which represents him as an old man with a long beard, and clothed in a loose robe, the head surrounded with rays, and a rugged stick in one hand, while the other is entwined with serpents. Games instituted in honour of the god of physic were celebrated, with great pomp, at Epidaurus every five years; and the cock, the raven, and the goat, were sacred to the same deity.

ÆSCULUS, the Chesnut and Horse-chesnut, a genus of plants belonging to the class Heptandria.

ÆSOP, the celebrated author, or supposed author, of the fables which have long afforded delight and instruction to childhood, was a native of Phrygia, and was born nearly 600 years before the Christian era. According to some accounts, Æsop was deformed in person, and, being a slave, continued in a state of servitude with many masters. Having obtained his liberty, the fame of his wisdom procured him an invitation to the court of Crœsus, king of Lydia; and by that monarch he was entrusted with an important mission to Delphi, to offer a sacrifice to Apollo, and to distribute a large sum of money among the people; but, in consequence of a dispute, the money was retained, and returned to Crœsus. The disappointed inhabitants charged Æsop with sacrilege, and he was convicted, and thrown headlong from a high rock. The allusions to be found in the works of Greek and Roman writers to Æsop, as the author of compositions in the form of fables, afford probable proof of such a person having existed; but no connected or consistent sketch of his life has been discovered in any ancient historian. The compilation of the biographical notices prefixed to the modern fables of Æsop in the fourteenth century, renders its authenticity doubtful; and even the collection of the writings which appear under his name, is supposed to have been made at no very distant period; and as it is well known to be a popular mode of conveying moral instruction in eastern countries, it may have been drawn from very different sources.

ÆTHER, from the Greek verb *to shine or burn*, is a term of frequent occurrence in the writings of ancient philosophers and poets, and denotes a fluid of extreme tenuity, or the pure element of fire greatly attenuated, which was supposed to occupy the utmost bounds of space, beyond the regions of our atmosphere, and to be in a state of constant revolution round the globe. It seems also to have been regarded as something of a divine or immortal nature; and the principle of life, and even the soul of man, "a portion of the divine spirit," were thought to be emanations from this æthereal matter. It would be in vain to search for any definition, or precise meaning of this term, in the works of ancient authors; and, perhaps, considering the variety of significations under which it has been employed, it ought rather to be received as an agreeable poetical fiction, than a philosophical truth. But in whatever sense it is used, when applied to natural objects, it invariably expresses something which is exceedingly pure and refined; and when it refers to animated or rational beings, it conveys the notion of the most placid enjoyment, the highest felicity.

ÆTHER, a light, volatile, and inflammable liquid, which is prepared by the action of acids on alcohol, when subjected to the process of distillation. Thus, sulphuric or vitriolic æther is obtained, by distilling sulphuric acid and alcohol together. See CHEMISTRY.

ÆTHUSA, Fools Parsley, a genus of plants belonging to the Pentandria class.

ÆTITES, or EGLESTONE, an argillaceus ore of iron, supposed to have been found in the eagle's nest, to which it was carried by the bird, to aid the process of incubation, and hence it derived its name.

ÆTNA, a lofty mountain of Sicily, celebrated from the earliest ages on account of its volcanic eruptions. See SICILY.

ÆTOLIA, a country of ancient Greece, including what is now called *Little Greece*, the southern boundary of which extends to the bay of Corinth. The Ætolians are described in different periods of their history, as a turbulent and restless people,—as plunderers or robbers, and in a state of constant hostility with their neighbours,—as inured to hardship, and patient of fatigue, dauntless in danger, and bold and enterprising in war;—as strongly attached to the republican form of government, jealous defenders of their liberties, and highly conspicuous among the other states of Greece for their bravery and perseverance in resisting the ambitious schemes of the Macedonian princes. But they were at last forced to submit to the overwhelming power of Philip, and yield up part of their territory to his dominion. The Ætolians, after a long struggle, and various success, were at last subdued by the Romans, and, with the other free states of Greece, were included in the province of Achaia; and the descendants of that brave people are now in a state of the most abject servitude to the Turks.

AFFECTION, when applied to matter, is nearly synonymous with property or quality, or it signifies those changes which are produced on bodies by the action of physical or chemical agents; but affection, considered as a mental operation, is a strong tendency of the mind, produced by some cause or agent, to communicate to others pleasure or pain, enjoyment or suffering. Moral writers have divided the affections into two classes, the benevolent and malevolent:—love, friendship, gratitude, belong to the first; hatred, jealousy, envy, revenge, fall under the second class. The exercise of the benevolent affections is accompanied with the most agreeable emotions, the most soothing delight; but inward agitation and disquiet, often depicted on the countenance, are the certain consequences of the indulgence of those of a contrary character.

AFFIDAVIT is a term chiefly confined to English law, and signifies a declaration upon oath, emitted before a magistrate, and committed to writing. Synonymous with affidavit is the oath of verity required from creditors, according to the Scotch bankrupt act.

AFFINITY is a term in law, expressive of that degree of kindred between a husband and the blood relations of the wife, or the contrary. By such connection, no real kindred is created; for no person can legally succeed to an inheritance in consequence of this affinity, whatever be its degree. The degrees of affinity are computed in the same way as those of consanguinity, or relationship by blood.

AFFINITY is employed to denote that property in the particles of matter by which they unite to form masses or new compounds. That property by which bodies are acted on at sensible distances, and are drawn towards each other, as the sun and planets, or a stone falling to the earth, is known by the general term *attraction*, or the *attraction of gravitation*; but the mutual action of bodies at insensible distances, is distinguished by the name of *chemical attraction*, or *affinity*. The latter term is now in general use in the language of modern chemistry. When the action between two polished surfaces of glass, marble, or metal is referred to, it is denominated *adhesion*; when the particles of the same kind of matter are united in masses, as a piece of stone or wood, it is called *cohesion*, or the affinity of aggregation; and when the particles of different kinds of matter combine together, and form a new compound, as sulphuric acid and lime, the union of which is plaster of Paris, it receives the name of the *affinity of composition*, *chemical* affinity, or simply *affinity*. See CHEMISTRY.

AFGHANS, or AFGHAUNS, a warlike people, who inhabit the mountainous regions on the borders of Persia, and occupy that district of country which lies between the Caspian sea and the Indus on the east, and between the same river and Cachmere on the west. As the Afghans have scarcely any resemblance to their Tartar neighbours, in their persons, manners, or language, the opinion is prevalent that they are descended from the Arabs. Sir William Jones was led to suppose, that the origin of this singular people was probably derived from the Jews; and he thinks this opinion receives confirmation from the accounts of the best Persian historians, from the traditionary history of the Afghans themselves, from the names of the Jewish tribes, by which many of their families are distinguished at the present day, although, it is said, they carefully conceal their origin since their conversion to Mahometanism, and from the affinity of their language to the Chaldaic.

Inhabiting a country inaccessible by nature, and enjoying none of the riches or luxuries which excite avarice or tempt ambition, the Afghans have retained their early customs and original character almost unchanged; and, secure amidst the rugged fastnesses of the mountains, have preserved their independence nearly unshaken. For, although they have nominally acknowledged their subjection to Persia, they were never conquered. Fierce and restless in their dis-

Afghans.

positions, they have been always more distinguished by their warlike achievements than by their love of the arts of civilized life. In the year 1712, they threw off the Persian yoke; advanced into the province of Candahar; took possession of the principal city, and afterwards of the whole province. Another tribe of Afghans revolted in 1717, and formed themselves into an independent republic. Mir Mahmud, a bold leader, united the different tribes of the Afghans with his own forces, for the purpose of subduing the whole of Persia, seized Ispahan, and established his own authority. Under the conduct of Mahmud's successor, the Abdollees, one of the tribes of Afghans took the field against the Turks; concluded a peace with them in 1727, and acknowledged the Ottoman emperor as the lawful sovereign of Persia. When Nadir Shah became master of Ispahan, he drove the Abdollees from their possessions; forced them to renounce their claims; in 1736, invaded their territory, and, having lost many of his troops, offered them peace, and invited them to join his army; and of all the Persian forces, the Afghans are distinguished as the bravest and hardiest soldiers.

AFRICA.

Africa.

AMONG the modern divisions of the globe, Africa ranks as third in point of size, though now inferior to all the other great continents in moral and political importance. Its boundaries are more clearly defined than those of the three other great divisions. They are, on the north, the Mediterranean sea; on the west, the Atlantic ocean; on the south, what is called the Southern ocean; on the east, the Indian ocean; and, on the north-east, the Arabian gulf, or Red sea, which separates it from Asia. Thus it is surrounded by water on all sides, except the narrow neck of land called the isthmus of Suez, by which only it is joined to Asia. In form, it has been represented as triangular, though it more nearly resembles a *trapezium*, the eastern border forming an acute angle at Cape Guardafui. Its general extent is not easily determined. From north to south, it occupies about 70° of latitude, equal to about 4900 British miles; while from Cape Verd on the west, to Cape Guardafui on the east, it extends through the same number of degrees, making its greatest breadth nearly equal to 4690 British miles.

Divisions.—Africa is divided among a great number of distinct tribes, or nations, of many of whom little more than the name is known. They may be classed as follows: On the north lie EGYPT, BARCA, TRIPOLI, BILED-UL-GERID, TUNIS, ALGIERS, FEZ, TAFILET, MOROCCO, and the great desert called SAHARA. Along the western coast lie the FOULAHS, FELOOPS, what is more particularly called the coast of GUINEA, including SIERRA-LEONE, the *Grain* coast, the *Ivory* coast, the *Gold* coast, and the *Slave* coast; the countries of POMBO and CONGO, comprehending LOANGO, ANGOLA, MATAMBA, and BENGUELA. In the southern division are situated the Great and Little NAMAQUAS; the HOTTENTOTS; the colony of the Cape of GOOD HOPE, and CAFFRARIA. The south-eastern coast comprehends the territories of BIRI, INHAMBANE, MANICA, SABIA, SOFALA, and MOZAMBIQUE; and along the eastern coast lie the kingdoms of MONGALLA and QUILOA; the country of the MONOMUGI; the territories of BRAVA, AZANIA, and ADEL; while the eastern shores of the Red sea are occupied chiefly by the extensive empire of ABYSSINIA, and the territories of SENAAR and DONGOLA. Beside these nations on the coast of Africa, the central parts of this great continent are inhabited by several tribes of whom a few only can be here noticed. These territories are SOUDAN, or NIGRITIA, including the empires of HOUSSA and TOMBUCTOO, and the kingdoms of BORNOU and DARFUR, the kingdom of AGADEZ, the territory of DONGA, and the country of the GAGAS.

Mountains.—In a tract of land so extensive as Africa, we might expect the face of the country to to be extremely various; this, however, is not in general the case. The greater part of the interior is composed of vast deserts, one of which comprehends a space of nearly two millions of square miles. The coast is in general low, except in Morocco, at the Cape of Good Hope and near the Mozambique channel; but a very remarkable chain of mountains is supposed to extend right across this continent from Cape Verd to Abyssinia.

Besides this extensive ridge of mountains generally called the Mountains of Kong, and the Mountains of the Moon, Africa boasts of Mount ATLAS, which passes from Biled-ul-Gerid, in a westerly and south-easterly direction, till it terminates in the southern boundary of Morocco. Another ridge runs along the the western shore of the Red sea, and is supposed to have formed the quarries from which the ancient Egyptians derived the materials of their obelisks. A considerable ridge traverses the kingdom of Darfur; and another called the *Mountains of Lupata* and sometimes the *Spine of the world*, forms the western boundary of ZANGUEBAR, extending nearly to the Cape of Good Hope. The only other high land of importance is the celebrated Table Mountain at the Cape. There are some volcanoes in Africa, but these are little known.

Capes.—From the indentations of the African coast, there arise numerous capes and gulphs. The principal capes are the following, viz. Cape Bon, in the territory of Tunis; Cape Spartel, forming the south-western coast of the straits of Gibraltar; Cape Geer, in the kingdom of Morocco; Cape Bojador, remarkable only as being the first new cape doubled by the Portuguese in the commencement of their maritime discoveries; Cape Blanc, in north latitude 21°; Cape Verd, latitude 15°; Cape Palmas, on the Ivory Coast; Cape Three-Points, on the Gold Coast; Cape Formoso, in the territory of WARI; Cape Lopez Gonzalvo, a little south of the equator; Cape Voltas, between the Great and Little Namaquas; Cape of Good Hope, forming the most southern promontory; Cape Sebastian, on the Mozambique channel; and Cape Guardafui, forming the most eastern promontory of Africa.

Gulphs.—The gulphs are very numerous. The most remarkable are those: Sidra, or Syrtu Gouletta, and Cabes, in the Mediterranean; the gulf of Guinea, in the Atlantic ocean; the gulf of Sofala, in the Mozambique channel; and the bay of Zeila, on the southern shore of the straits of Babelmandel.

Rivers.—The rivers of Africa, considering the great extent of this division of the globe, appear not to be so numerous as those of either Asia or America. The interior of the country, in particular, seems nearly devoid of navigable streams, if we except the NILE and the NIGER,—those two great approbria of modern geographers, of which neither the source of the former, nor the termination of the latter, has been ascertained with certainty.

The Nile is supposed to derive its source from that ridge of the Mountains of the Moon that traverses the territory of Donga, whence, under the name of Bahr El Abiad, it takes an easterly and north-easterly course to the borders of Abyssinia. From this it runs nearly due north, between Kordofan and Senaar; traverses Nubia and Dongola, in a winding course; enters Egypt, and passes directly north to the Mediterranean sea.

Of the Niger, much less is known than of the Nile. We know that it originates in the western ridge of the mountains of Kong; from which it flows easterly, north-easterly, and easterly, through the kingdom of Bambara, and the empires of Houssa and Tombuctoo; but whether it terminates in a considerable lake to the west of Darfur, or takes a southerly direction through the Mountains of the Moon, and finally disembogues itself into the southern Atlantic ocean, by one of those openings which are now known under other names, is not yet determined. It seems probable, however, that the Niger does pass to the southward; and if it do not form one continued stream, that it unites itself with the large and rapid river denominated Congo, or Zayr.

The river Congo may be considered as the third in point of importance. Its source is not known, though it evidently comes from the northward, and, after traversing the kingdom of Congo, joins the Atlantic at about the 12th degree of south latitude. Here it is about 15 miles wide, and so rapid as to repel the waters of the ocean to a distance of many miles from the coast. Near its mouth it is a hundred fathoms deep; and at ninety miles above its mouth, its width is a mile and a half, and its depth above thirty fathoms.

The other African rivers of note are, the Senegal and the Gambia, both rising in the mountains of Kong, and flowing into the northern Atlantic, opposite the Cape de Verd islands; the Orange river, which probably rises in the southern ridge of the mountains of Lupata, and flows westerly for nearly 1000 miles, till it meets the southern Atlantic, between the Great and Little Namaquas; the Zambe, opening into the Mozambique channel, and the Hawash into the straits of Babelmandel.

Lakes.—It is probable, that such an extensive tract of country contains numerous and considerable lakes, though few of these are known to modern geographers. The most considerable with which we are acquainted, are, Lake Maravi, to the west of the mountains of Lupata; Tzana, or Dembea, near Gondar, in Abyssinia; Menzala, in Berlos; and Elko, in Egypt; and Maberia, in Nigritia, which is said to give origin to the river Senegal.

Islands.—Several important islands are described as belonging to Africa; especially, Madagascar, reckoned the third island, in point of size, on the globe; the Canary islands, opposite the coast of Morocco; the Cape Verd islands; the island of St Thomas, almost at the equator; and St Helena, which, though insignificant in point of magnitude, is now become of no small importance in the eyes of Europe, as the future residence of Napoleon Buonaparte.

Oases.—Similar to the islands in the Atlantic and Indian ocean, are those remarkable isolated spots of cultivated land in the midst of the extensive African deserts, which give shelter to a few wandering tribes, and afford welcome resting places to the trading caravans. These are called *Oases*, and are pretty numerous. The most remarkable are those of Fezzan, Agadez, Augila, Gualata, Tuat, Taboo, Gadamis, and Berdoa.

Climate and seasons.—As Africa is almost equally divided by the equator, by far the greater part of this continent lies between the tropics. From this situation, added to the immense arid deserts of the interior, the climate of Africa is, in general, the hottest of any part of the globe. Even the natives can scarcely endure the scorching rays of the mid-day sun; and many Europeans have, in vain, attempted to advance far beyond the coasts. The sands are so parched with the continued influence of the solar rays, that even the wind which passes over them produces effects on the skin and lungs almost equal to those of the blast of a furnace; and the scarcity of water is so great, that caravans sometimes perish from thirst, or are compelled to slaughter their camels for the small quantity of water contained in the reservoirs of those animals. Along the coasts the air is somewhat more temperate; though in the neighbourhood of the large rivers, the climate is still injurious to health. It is said, that the districts to the south of the equator are less torrid than those within the northern tropic, which is accounted for from the former being more within the influence of breezes from the sea.

Almost the whole of Africa lies in the torrid zone; and the year, as in other intra-tropical regions, is nearly equally divided between the dry and the rainy seasons. The latter is peculiarly unfavourable to the human constitution, so that during that season no expeditions of any consequence, either warlike or commercial, are undertaken.

Natural History.—The natural history of Africa is copious and interesting, and will be particularly noticed in describing the empires and kingdoms of which this continent is composed. We shall here confine ourselves to very general remarks. Among the mammalia found in Africa, the most remarkable are the Barbary and Pigmy apes, the great baboon, the rhinoceros, especially the two horned species, which is common at the Cape of Good Hope; the elephant, which is most abundant in the island of Bulama, and in South Africa; the hyena, the fennec, the lion, who appears in Africa in his greatest strength and terrors; the cat of Angora; the ichneumon, found chiefly in Egypt; the porcupine, the Madagascar squirrel, the jerboa, the hyrax; the camel, the camelopardalis, or giraffe, sometimes seen at the Cape of Good Hope; numerous species of antelopes, the Guinea sheep, the buffalo, the zebra, the quagga, the hippopotamus, or river horse, and the Ethiopian and Cape de Verd hog: it seems probable, from Mr Barrow's account, that even the unicorn, generally supposed a fabulous animal, may exist in Southern Africa.

The species of birds found in Africa are almost innumerable. We may, however, particularize the golden eagle, the ibis, the vulture, the flamingo, and the ostrich. Of these the ibis is said not to be at present met with in Egypt, though sometimes seen about the Cape of Good Hope. Of the reptiles, the most remarkable is the crocodile, a native both of Egypt and Abyssinia.

The insects found in various parts of Africa are so numerous, that a bare catalogue of those that are known would occupy a very considerable space; and every succeeding traveller, since the time of Vaillant, is continually adding to the number. Among the most extraordinary may be noticed the termes, or white ant.

Progressive Geography.—There are few subjects more interesting than the progressive geography of Africa. The knowledge which the ancients possessed of this large continent, was confined almost entirely to what is now called Northern Africa. The principal ancient divisions of Africa were, Egypt, Cyrenaica, the modern Barca, regio Syrtica, now Tripoli, Africa Propria, chiefly confined to the territories of Carthage, the modern Tunis, Numidia, now Algiers, Mauritania and Getulia, the modern Morocco and Fez. The northern part of the interior was called Lybia, and the southern Ethiopia. The idea formed by ancient geographers of the form of this continent, was, however, extremely inaccurate. They supposed that its breadth increased gradually towards the south. Of the interior almost nothing was known, though even Herodotus mentions the river Niger, and describes it as flowing towards the east.

Attempts were made, at a very early period, to improve the geographical knowledge of Africa. The earliest of these appears to have been that of the Phœnicians in the reign of Pharaoh Necho, king of Egypt, about 604 years before the Christian era. These Phœnician navigators, according to Herodotus, set out from a port in the Red sea, and passing the straits of Babelmandel, entered the southern ocean. On the approach of autumn, they landed in what Herodotus calls Lybia, where they remained for nearly a year, so as to reap corn which they had sown on their first arrival. Hence they again set out, and coasted round Africa, till, in the third year, they passed the columns of Hercules, and returned to Egypt by the Mediterranean. Much doubt is entertained with respect to the authenticity of this account of the Phœnician circumnavigation of Africa. There is only one circumstance which might induce us to believe that it really took place, viz. that it is related of these voyagers, that in the latter part of their voyage they had the sun on their right hand, which could have happened only from their crossing the equator. On the other hand, when we reflect on the imperfect state of navigation at that early period, and the difficulties and dangers which must have attended such an undertaking, we can scarcely believe it would prove successful.

Voyage of Hanno.—Posterior to this attempt of Pharaoh Necho, and some centuries before Christ, the Carthaginians fitted out a fleet, under the command of Hanno, for the purpose of exploring the western coast of Africa, and establishing a traffic with the natives. As this is the first voyage of discovery of which we have any authentic record, we shall here introduce the account of it, which was drawn up by order of the Carthaginian government, and deposited in the temple of Saturn.

The fleet consisted of sixty ships, having on board thirty thousand souls, well provided with all necessaries. After passing through the straits of Gibraltar, and sailing for two days southwards, the navigators landed, and built a city called Thymaterium, supposed to be the modern Azamor. Hence coasting towards the west, they came to the promontory of Soloeis, supposed by Major Rennel to be that now called Cantin; and having here built a temple to Neptune, they sailed half a day eastward, along a country abounding with elephants. After proceeding one day's sail to the south, they again landed, and built six towns; and again setting sail, came to a river which they called the Great River Lixus, the modern site of which is not certainly ascertained, though it is probably the Lucos, near Santa Cruz. Pursuing their voyage for one day toward the east, they came to a small island, which they called Cerne, where they staid some time. Departing hence, and sailing by a great river called Chretes, they came to what is called a lake, or large opening of the sea, in which were several islands. In this opening they sailed for the space of a day, and saw several high mountains inhabited by savage people clothed with skins. This lake or opening is, by Major Rennel, supposed to have been the mouth of the Gambia; so that if his opinion be correct, Hanno and his companions must have proceeded pretty far to the south.

Discoveries of the Moderns.—From the voyage of Hanno, nothing seems to have been done towards investigating the geography of Africa till the fourteenth century, when, in consequence of a grant from Pope Clement VI., by which the Canary islands, then little known, were bestowed on Louis de la Cerda, of the royal family of Castile, these islands became an object of serious consideration. Accordingly, about 1395, they were taken possession of by John de Betancourt, who made a pretty accurate survey of them.

In the beginning of the fifteenth century, in the reign of John I. king of Portugal, a voyage of discovery was undertaken by direction of Prince Henry, fourth son of that monarch. Hitherto the western coast of Africa had been explored only as far as Cape Non or Nun; but this expedition advanced consi-

Africa. derably to the south of that promontory, and discovered Cape Bojador. In several successive voyages, during the early part of the fifteenth century, the maritime discoveries of the Portuguese were continually extended. In 1418, the island of Porto Santo was first seen; in 1420, the island of Madeira, discovered the preceding year, was explored; in 1434, Cape Bojador was doubled; in 1446, Cape de Verd was discovered and doubled; in the following year the discoveries had reached the river Gambia, then called Rio Grande; in 1449 were discovered the islands called Azores; about 1456, the Cape de Verd islands appear to have been first noticed; in 1460 the coast of Sierra Leone was first observed; in 1471 several small islands were discovered, especially that of St Thomas; in 1480 the Portuguese navigators proceeded as far as the river Congo, or Zayre; and in 1487 our knowledge of the western coast of Africa was completed by the discovery of the Cape of Good Hope; in 1498 the intrepid Vasquez de Gama doubled the Cape of Good Hope, and examined the coast of Zanquebar; and thus, in the course of a few years, the whole outline of the African continent was completely traced.

Still the interior of the continent was scarcely known. The Portuguese merchants and missionaries from time to time published accounts of the nations on the eastern and western coasts, and the Dutch afforded considerable information respecting the country immediately contiguous to the Cape, but none of these accounts extended our knowledge a hundred miles within the country. The importance both to commerce and to science of an accurate acquaintance with the interior of Africa, at length, towards the conclusion of the eighteenth century, roused the attention, and excited the genius both of public bodies and private individuals. Abyssinia was explored by Bruce, Egypt by Volney and Sonnini, the Cape of Good Hope by Sparrman and Barrow, Madagascar by Rochou, Darfur by Browne, and Nigritia and the western nations by later travellers, of whose journies we shall now proceed to give a more minute account.

Journey of Ledyard.—In the year 1788, a society was formed at London of about ninety-five gentlemen of rank and learning, for promoting discovery in the interior parts of Africa. To this *African Association*, as it is generally called, we are indebted for much valuable information, though their laudable exertions have not been attended with all the success that could have been desired; and several gentlemen have fallen victims to their enterprising spirit, in endeavouring to execute the office assigned them by the society.

The first traveller who offered his services in prosecuting the views of the African Association, was Ledyard, an American, a man of great intrepidity and penetrating genius, who had already passed many years in travelling over various parts of Asia and Europe, and had accompanied Captain Cook in one of his voyages round the world. In consequence of a recommendation from Sir Joseph Banks, Mr Ledyard was appointed by the Association to explore the interior of Africa, from Egypt to the Niger, in the direction of Senaar, and left London, for this purpose, on the 30th of June 1788. In little more than a month, he arrived at Alexandria, in Egypt, where he procured the habit of an Egyptian traveller, with such instructions as might enable him to act up to the character he had assumed. He then repaired to Cairo, which he reached on the 19th of August; and where he remained, till, by conversing with the travelling merchants who formed the caravans that annually traverse the African deserts, he had acquired considerable knowledge of the countries through which he had to pass, and the manners and customs of their inhabitants. Before he could set out from Cairo, however, in further prosecution of his journey, he was seized with a bilious complaint, which soon put a melancholy period to his existence, and deprived the public of those services which he appeared so well qualified to perform. Africa.

From the observations made by Mr Ledyard while at Cairo, as published in the proceedings of the African Association, we collect the following particulars: The travelling merchants, or Jalebs, traffic to Senaar, Darfur, Wangara, and Abyssinia. To the first of these places, they generally carry trinkets, which they barter with the natives for elephants' teeth, gum, ostrich feathers, slaves, and camels. Much of the trade between Senaar and Cairo is carried on in the name of the king of Senaar, who is himself a merchant, and has a factor at Cairo. From Darfur, the Jalebs also bring gum, ivory, and slaves. The inhabitants of Darfur were represented to Mr Ledyard as being in the lowest state of savage society. From Wangara these merchants bring gold, with which that kingdom is said to be abundantly supplied, though the king is generally careful not to make an ostentatious display of the riches of his country, for fear of attracting the notice of his poorer neighbours. The caravans estimate the distance of places in their route by the days required to travel from one to another; and as these journies are generally performed on camels, whose ordinary rate of travelling is 20 miles per day, these distances are easily computed. Thus, from Cairo to Senaar is 30 days journey, or 600 miles; to Fezzan is 50 days, or 1000 miles; and from Fezzan to Tombuctoo is 90 days journey, or 1800 miles.

Mr Lucas.—In the same year, (1788,) the Association engaged Mr Lucas, who, after having passed three years as a slave in Morocco, had resided in that empire for 16 years in the character of British vice-consul, to explore the great desert from Tripoli to Fezzan, from which he was to return by the river Gambia on the coast of Guinea. Mr Lucas sailed from Marseilles on the 18th October 1778, and a week after landed at Tripoli. He here met with two shereefs who had brought from Fezzan slaves, senna, and other commodities. Under the protection of these shereefs, who, being descended from Mahommed, were regarded as sacred both in their person and property by the predatory tribes of the desert, he set out from Tripoli on the 1st of February 1789, provided with a good mule from the bashaw of Tripoli, and a letter of recommendation from the bey to the king of Fezzan. After passing two days and a half in travelling among dreary hills of loose sand, which was agitated by every breeze, they came to a spot in which were a few fields of corn, diversified with date and olive trees; and, on the fourth day, after a tedious march of three hours among rocky hills, they arrived at an extensive plain abounding in those fruit trees, which here grow in great luxuriance. This plain is not far from the sea coast, and near it lies the town of Lebida, where Mr Lucas saw the ruins of a Roman temple, of several triumphal arches, and a large aqueduct by which water had once been conveyed to Libida from a neighbouring hill. On the seventh day of their journey, they encountered a party of Arabs whom they suspected to be enemies, and prepared to attack them; but fortunately the Arabs and the shereefs were known to each other, and the threatened battle was exchanged for a scene of festivity. On the evening of this day, they reached Mesurata, where Mr Lucas was politely received by the governor; but finding it impossible to obtain a sufficient number of camels for the journey to Fezzan, he abandoned the journey for that season, and returned to Tripoli, from which he set out by way of Malta and Marseilles, and arrived in England on the 26th of July.

It does not appear that much information was obtained by Mr Lucas, either on his journey from Tripoli to Mesurata, or during his stay at this latter place. He observed, indeed, that the merchants of the caravan seldom encumber themselves with tents, but when they encamp for the night they unload their beasts, arrange their goods and baggage in a circle, within which they light fires, and repose themselves on mats, without any other covering than their alhaiques or blankets; and he learned from Ben Ali, a native of Morocco, some new intelligence respecting the route of caravans from Fezzan to the Niger, by the way of Bornou and Kashna.

Major Houghton.—The next adventurer who undertook to explore the interior of Africa, was Major Houghton, an officer in the British service, who had passed some time as fort-major in the African island of Goree. The African Association had received from an Arab, named Shabeni, a very interesting and extraordinary account of the empire of Houssa, adjacent to Tombuctoo, the capital of which was described as not inferior to London or Cairo in extent and population, while he represented the inhabitants as arrived at a high degree of civilization and refinement, living under the government of a limited monarchy, and the restrictions of written laws, and even possessing a considerable share of literary knowledge. For the purpose of ascertaining the truth of these surprising reports, Major Houghton was engaged by the Association; and he was instructed to proceed by the shortest route to the Niger, of which he was to ascertain the course, and, if possible, the rise and termination; to visit the cities of Tombuctoo and Houssa; and having acquired all the information in his power, he was to return by way of the desert, or by such other route as should be most convenient.

In compliance with these instructions, Major Houghton left England on the 16th of October 1790, arrived at the mouth of the Gambia on the 10th of the following November; and was hospitably received by the king of Barra, to whom he was known, and who assured him of all the assistance and protection in his power to afford. Having procured an interpreter, he sailed up the river to Junkiconda, where he purchased a horse and asses for the purpose of conveying his goods to Madina the chief town of the kingdom of Woolli. Here he arrived after a difficult and dangerous journey, and was kindly received by the king of the country; but before he left the town, his farther progress was nearly arrested by a fire which broke out in the habitation where he had fixed his residence, and consumed the greater part of his merchandize, while his interpreter ran off with his horse and most of his asses. He left Madina on the 5th of May, and pursuing a north-easterly course for five days, arrived at the frontier of the kingdom of Bondou, adjoining to Woolli. He now traversed a tract of 450 miles, till he arrived at the banks of a river called Faleme, which constitutes the south-western boundary of the kingdom of Bambouk. In consequence of a war between the king of this country and the sovereign of Bondou, the unsuccessful termination of which had compelled the former to relinquish a part of his territories, Major Houghton found himself under very unpleasant circumstances. The king of Bondou was now residing in his newly acquired possessions, and not only received our traveller in a very ungracious manner, but either authorised or permitted his son, with a body of armed men, to rob him of almost all his baggage and effects. At length he found means to escape, and was proceeding on his way to the capital of Bambouk, when he missed his road in the midst of a forest, and was compelled to pass the night on the ground, exposed to all the inclemencies of the rainy season. The consequence was a violent fever, accompanied with delirium; under which he would have sunk, but for the kindness and hospitality of a negro family, to whom he had been conducted by his guide. His reception by the King of Bambouk was flattering, and such as seemed to promise future advantages to the cause in which he was embarked. In the course of July he became acquainted with a respectable Bambouk merchant, who agreed to conduct him on horseback to Tombuctoo, and return with him to Junkiconda, for which the merchant was to receive L.150 Sterling, on their arrival at the British factory. We have no further authentic account of Major Houghton's adventures; but it was reported by the natives of Ludamar, that on arriving at Jarra, he was prevailed on by some Moorish merchants to accompany them to the salt mine of Tissheet, considerably to the north of his intended course, and it is supposed that he was either murdered by his treacherous conductors, or, after being rifled of his remaining effects, was left to perish in the woods or the desert.

Much curious information has been derived from Major Houghton's dispatches. He describes the kingdom of Woolli as a delightful country, abounding with all the necessaries and conveniencies of life, and well situated for an extensive and profitable commerce. The inhabitants of Bondou, like the Arabs, have long black hair and copper-coloured complexions, and belong to the tribe of Foulahs, who occupy the greater part of the district between the Senegal and Gambia. The inhabitants of Bambouk, again, are of the negro race, are engaged chiefly in agriculture, and have made little progress in arts and manufactures. Like almost all the other negro tribes, they are a nation of robbers.

Mr Park.—We now come to the most enterprising, and, on the whole, the most successful of the travellers who have undertaken to explore the banks of the Niger, the celebrated Mungo Park. This gentleman had just returned from India, and as the African Association were then looking out for a proper person to supply the place of Major Houghton, Mr Park eagerly offered his services, and, after some enquiry into his qualifications, his offer was accepted.

He sailed from Portsmouth on the 22d of May 1795, and arrived at Jillifree, on the north bank of the Gambia, on the 21st of the following month. Hence he proceeded to Pisania, a British factory, about 200 miles up that river. He was most kindly received by Dr Laidley, and remained for several months, collecting information respecting his intended journey, and learning the Mandingo language.

Leaving Pisania, on the 2d December 1795, and directing his course to the Niger, or Joliba, he soon found it necessary, in consequence of a war between two chiefs of the interior, to make a turn to the northward, towards the territory of the Moors; and, on the 7th March, was taken prisoner by Ali, a Moorish chieftain. After a series of unexampled hardships, he escaped, with great difficulty, in the following July; and, after wandering for three weeks through a wilderness, arrived at Sego, the chief town of the kingdom of Bambarra, situated on the banks of the Niger, and containing, by computation, about 30,000 inhabitants. Finding it would not be safe for him to remain long at Sego, he proceeded by Sansanding to Silla, a town on the south side of the Niger, about 70 or 80 miles farther down the stream. Here he found that, in his unprotected situation, there were insurmountable obstacles to his farther progress, and therefore returned up the current of the Niger, till he reached Bammakoo, on the frontiers of Bambarra, on the 23d of August. The Niger was here no longer navigable, and he was obliged to travel for several weeks on foot, in the worst of the rainy season, wandering alone, and deprived of every convenience that might alleviate his distress, through a mountainous and pathless country; and on the 16th of September arrived at Kamalia in the kingdom of Manding, situated at the foot of some rocky hills, and noted for the gold which is collected in its neighbourhood. The fatigue and hardships to which he had been exposed, brought on a severe and dangerous illness, by which he was confined for several weeks, and appears to have owed his life to the benevolent attentions of his host, a negro slave-merchant, called Karfa Taura, whose family nursed him with the kindest solicitude. He had still 500 miles to travel, chiefly through a desert country, before he could reach any friendly district on the banks of the Gambia, and no opportunity occurred that could afford any chance of accomplishing so long and perilous a journey till the month of April 1797, when he heard of a caravan of slaves who were moving to the westward. These he joined, and left Kamalia on the 19th of April. On the 3d of May they entered Malacotta, a small unwalled town, consisting of huts formed of split cane, plastered with mud. There they remained four days, and on the 12th of May crossed the river Faleme. On the 4th June they reached Madina, the capital of Woolli; and on the 10th of the same month arrived at Pisania, which he had left 18 months before. After remaining about five days, he embarked in a slave ship bound to America; and being by stress of weather driven to Antigua, he left the ship, sailed from Antigua on the 24th November, in a British vessel; and on the 22d December arrived at Falmouth, having been absent two years and seven months.

It must be confessed, that the objects for which Mr Park undertook his first journey were not completely fulfilled. He ascertained neither the origin nor the termination of the mysterious Niger, though he had ocular demonstration of the truth of the assertion made by Herodotus, that the course of this river is towards the east. He has also fixed the boundaries of several moorish and negro nations, and brought us acquainted with many interesting circumstances respecting their manners and customs. In particular, he has admirably depicted the character of the Mandingo tribes, and of those wandering hordes of Bedouin Arabs that rove through the extensive district of Ludamar. In short, he has fixed the geographical position of a great number of towns and villages on the banks of the Gambia, the Senegal, the Faleme, and the Niger; and although he was unable to ascertain the truth of the Arabian reports respecting the empires and cities on the banks of this great river, he saw and described enough to convince us that they are at least highly probable.

Mr Horneman.—Before Mr Park's return from his first journey, another gentleman had presented himself to the African Association. This was a young German, of the name of Horneman, of respectable literary attainments, of athletic form, vigorous constitution, and temperate habits; qualifications which certainly fitted him in an eminent degree for executing the arduous task he was about to undertake. He came to London in the spring of 1797, was soon appointed by the Association, and in the autumn of the same year left England for the south of France. He sailed from Marseilles in a Cyprus vessel in the month of August, and landed at Alexandria in Egypt on the 10th September. He soon left this city for Cairo, where, like his predecessor Ledyard, he passed some time waiting for the departure of the caravan for Fezzan; and acquiring such information as might assist him in his future progress. It appears that he set out for Fezzan; but as no authentic accounts have arrived of his proceedings after that period, it is to be apprehended that he has fallen a prey to the insalubrity of the climate, or the treachery and inhumanity of the natives.

Mr Park's second journey.—After the peace of Amiens, it was resolved by the British government to dispatch a mission to Africa, under their immediate authority and direction, for the purposes of ascertaining how far it might be practicable to establish a commercial intercourse, through the medium of our settlements on the Gambia, between this country and the nations that inhabit the banks of the Niger. It

Africa. is not surprising that Mr Park should have been selected as the fittest person to carry into effect this important resolution; nor, considering his enthusiastic turn of mind, it is not to be wondered at that he should eagerly embrace the offer. This offer was made in the autumn of 1803, and he came to London at the end of that year to arrange measures for his journey. In consequence, however, of the change of government which took place in May 1804, the business of the African mission was successively delayed, first till the following September, and afterwards till January 1805.

On the 30th of this month, Mr Park embarked at Portsmouth, and took his final leave of his native country, to which he was destined never to return. He was accompanied from Britain by Mr Anderson, his brother-in-law, a respectable surgeon, by Mr Scott, a draughtsman, and four ship-carpenters; and it was settled that, on his arrival at Goree, he was to be joined by a detachment of volunteers from the royal artillery. It was naturally supposed, that, protected by such a guard, our travellers would have nothing to fear from the undisciplined savages through whose country they had to pass; and indeed there is every reason to believe, that had the expedition taken place some months earlier, it would have been attended with complete success.

The Crescent transport, having on board Mr Park and his companions, touched at Porto Praya in St Jago, one of the Cape de Verd islands, on the 8th of March, for the purpose of supplying themselves with asses; and having obtained a sufficient number, they left the island on the 21st, and seven days after landed at Goree. They speedily procured their compliment of soldiers, consisting of Lieutenant Martyn and 34 privates, forming part of the garrison of Goree. By the 26th of April our little army had reached Kayee, a small town on the banks of the Gambia, from which they set out in good health and high spirits, on their eventful journey towards the Niger. It soon appeared how just had been the apprehensions which Park had frequently expressed, of undertaking this journey at such a season of the year; and it is much to be lamented that the arduous leader of the party had not delayed his final departure from the British settlements till the tropical rains and excessive heats which attended them had subsided. It would be a melancholy task to follow this devoted party in their march through the woody and mountainous districts that lie between the Gambia and the Niger. It is sufficient to observe, that, by the time they reached Sansanding on the latter river, only five out of 44 Europeans who left Goree survived. These were Mr Park, Lieutenant Martyn, and three of the soldiers. Their number had almost daily diminished from the 8th of June, when they encountered a heavy tornado near Dentila, till the 28th October, when Mr Anderson was laid in the grave. All the carpenters had died; and it was with great labour and difficulty that Mr Park, aided by one of the remaining soldiers, joined together two halves of a Bambarra canoe, so as form something like a schooner, which he denominated the Joliba.

Mr Park's death.—With this schooner and his small remaining party, one of whom was in a state of derangement, Mr Park determined to undertake a voyage down the Niger till he should reach its termination or "perish in the attempt." Unfortunately he did perish long before he reached its termination. There are no certain accounts of the particulars of this melancholy event; but it appears from the journal of his guides Isaaco and Amadou Fatouma, that the party, after leaving Sansanding on or about the 17th November, (the date of Mr Park's last dispatch,) proceeded down the Niger till they reached Yaour, in the kingdom of Houssa, near which they were attacked by the natives, and either put to death by their spears or drowned in the river. Africa.

The second journey of Park has added but little to our geographical knowledge of the interior of Africa. Sansanding, from which government received the last authentic dispatch, is several miles higher up the river than Silla, to which place the accounts of his former journey extended. Several additional circumstances are, however, to be gleaned from the journal that accompanied the last dispatch, and the most important of these we shall here notice.

The river Gambia at Kussai, nearly 300 miles above its mouth, is at least 100 yards across, and has a regular tide, rising about four inches. It swarms with crocodiles and river horses, so that 13 of the former and 3 of the latter were seen at one time. The woods in this neighbourhood abound with wild bees, and honey is of course very plentiful. At Dentila, the tree which produces the astringent drug kino, is so plentiful that they use it for smelting iron. At Shrondo and Dindikoo are gold mines, which are merely pits sunk in the earth, in a marshy soil, to the depth of 10 or 12 feet, and the gold is obtained in minute particles by washing the soil. The mountains here consist chiefly of a coarse reddish granite, but their surface is so fertile that they are cultivated to their very summits. Several of the tributary streams passed by Mr Park are very large, particularly that called Ba-fing, at Konkromo, where a canoe in which were three soldiers was upset, and the Ba-Woolima, in which the guide Isaaco was nearly killed by a crocodile. Almost through their whole journey they were continually pestered by the thievish disposition of the natives. Indeed, according to their own account, they considered the coffle "as a *dummulafong, a thing sent to be eaten:* in English, fair game for every body." The main stream of the Niger, is separated from the remote branches of the Senegal by a ridge of mountains at the south of Toriba; and a little to the east of Bammakoo, the Niger is at least a mile in breadth, and the current sets nearly five miles an hour. Nothing can be conceived more beautiful than the views of this immense river, sometimes as smooth as a mirror, sometimes ruffled with a gentle breeze, down the current of which the canoes moved, without exertion, at from five to seven miles an hour.

The town of Sansanding is not so large as Sego, containing only about 11,000 inhabitants. It has no public buildings except the mosques. There is a large square market-place; and the different articles of merchandise are exposed for sale on stalls covered with mats to shade them from the sun. The market is crowded with people from morning to night.

Africa.

The articles sold are chiefly beads, indigo, wood, ashes, cloth from Houssa and Jinnie, antimony, sulphur, rings and bracelets of copper and silver, scarlet, amber, Morocco silks, tobacco, and salt. Besides the ordinary market-places, there is a very large space appropriated to the weekly market, held every Tuesday, on which day astonishing crowds of people come from the country to purchase articles in wholesale, which they retail in the neighbouring villages.

From the experience we now possess, and from the observations of the lamented Park, there can be no doubt that it is practicable to open a commercial intercourse between the great trading cities on the banks of the Niger, and the British settlements on the Senegal and the Gambia; but for this purpose the traders must be supported by a sufficient force, and must make their expeditions during the dry season. The British government have had it long in contemplation to renew the attempt in which Park so unavoidably failed, adopting such measures of prudence as shall, so far as human exertion is concerned, ensure success; and according to this system of precaution a mission has been appointed, and is now (November 1815) about to depart for the coast of Africa.

Before concluding this sketch of the discoveries in this extensive continent, we must notice the mission of Messrs Trutter and Somerville from the Cape of Good Hope in 1801 and 1802, the travels of Dr Lichtenstein, a German, at a later period, and the missionary journey of Mr Campbell, of a still more recent date; from all of whom much curious and interesting information, relative to Southern Africa, has been obtained. These travellers explored a considerable extent of country, and between the 20th and 28th degree of south latitude discovered a very populous region, inhabited by a tribe called Boshuanas, who have made some progress in civilization and the arts of life, and reside in villages and towns of no trifling magnitude. Leetakoo, or Latakoo, the capital of the Matchappin tribe, contains from 10 to 15,000 inhabitants. Agriculture is an object of assiduous attention in this part of Africa, and has made such advances, that corn and bean crops are successfully raised in inclosed fields. Southward from Leetakoo, are the Wanketzens, who are described as a more numerous tribe, have reached higher degrees of perfection in agriculture, live in larger towns, and are not meanly skilled in the manufacture of arms and other works in iron.

Aga || Agamemnon

AFRICAN COMPANY. See COMPANY.

AFRICAN INSTITUTION. See INSTITUTION.

AGA, a title of distinction among the Turks; as, the *aga*, or commander of the janizaries; the *spahiclar aga*, or general of the horse; and the *agas*, or chief officers of the seraglio. The principal officers of the khan of Tartary, and the governors of towns and garrisons among the Algerines, are distinguished by the same title.

AGADEZ, a region in the interior of Africa, situated in the eastern part of the Great Desert, of which the northern district is a barren sandy waste; the southern contains rich pastures, is fruitful in corn, and abounds with cattle. Three towns of this district are considerable for their wealth and population. Agad, the capital, is placed between two lofty mountains, near the source of a stream which falls into the Niger. It is surrounded with walls, and the houses are built in the Moorish style. The natives of the country resemble the wandering Arabs in their mode of life, and have some trade in manna and senna. Agad is situated in N. Lat. 20. 15. E. Long. 13. 14.

AGALMATOLITE, or Figure Stone, a species of mineral belonging to the Magnesian genus. See MINERALOGY.

AGAMEMNON, king of Argos, and the celebrated commander of the Greeks in the Trojan war. Agamemnon drove Thyestes, and his son Ægisthus, from the government of Argos, which they had usurped; and having ascended the throne, married Clytemnestra, daughter of Tyndarus, king of Sparta. As Agamemnon was the most powerful prince in Greece, he equipped the greatest number of ships and men for the expedition against Troy; and, during that famous siege, his courage, prudence, and perseverance were always conspicuous. After its fall, the prophetess Cassandra, the daughter of Priam, became the prize of Agamemnon; and by her he was warned against returning to Mycenae, on account of the plot which was formed against his life; but he disregarded the advice, and was basely murdered by his wife and her lover Ægisthus, who, during his absence, had seized the throne of Argos.

Aganippe || Agaric.

AGANIPPE, a fountain of Mount Helicon, sacred to the muses, and celebrated by ancient poets; and hence Aganippides is one of the designations of the muses.

AGAPANTHUS, signifying love-flower, a genus of plants belonging to the class Hexandria.

AGAPE, from the Greek word which signifies *love*; the love-feast or feast of charity which was instituted among the primitive Christians, and was provided by the rich to supply the necessities of the poor. It is said that the feast of love was established when the practice of having all things in common ceased. This festival was held after the service of the church ended, and also at the time of the celebration of the Lord's supper. But, about the end of the fourth century, the licentious abuses which had crept into the institution, required the interference of the council of Carthage, and occasioned a direct prohibition of its observance in churches. Among certain religious denominations, as the Baptists and Glassites, feasts of a similar nature exist at the present day, and are conducted with great propriety and decorum.

AGAPETÆ, the denomination of certain widows and virgins, who, from motives of piety and charity, attended ecclesiastics, and aided them in their functions in the early times of the Christian church.

AGARIC, Mineral, a carbonate of lime found in the fissures of rocks. See MINERALOGY.

AGARICUS, or Agaric, a genus of plants belonging to the class Cryptogamia.

AGATE, a mineral composed chiefly of jasper and calcedony, with some other simple minerals, usually disposed in concentric layers. See Mineralogy.

Agate, is also the name of an antique gem, on which are engraven representations of events relative to ancient history and mythology. Some of these gems are beautifully executed, have been preserved with great care, and are still held in high estimation.

AGATHOCLES, the tyrant of Sicily, holds a conspicuous place in history, on account of the eventful scenes of his varied life. He is described as the son of a potter, and was born 361 years before the Christian era. After a succession of adventures, in which he appeared in the character of a common soldier, a robber, and a pirate, as suited his necessities, or accorded with his bold designs, he rose to the high rank of commander in chief of the army of Syracuse. The death of Timoleon, through whose vigorous measures the expulsion of the tyrants, and the restoration of the liberty of the Sicilians had been accomplished, opened the path of ambition to Agathocles, who now aspired at sovereign authority. But he was not permitted to assume the reins of government till he came under a solemn engagement to preserve its democratic form unimpaired. With supreme power in his hands, the obligation of an oath proved a feeble restraint on the cruelty of an unprincipled ruler. Four thousand of the nobles and principal citizens, who were not disposed to acknowledge the absolute authority which he assumed, fell victims to his barbarity and ambition. The Carthaginians, who at this time held part of the Sicilian territory, became jealous of his power, declared war against him, and, after a successful engagement in the field, drove him within the walls of the city. But while he was deserted by his allies, and harassed with all the privations and miseries of a siege, his spirit remained unbroken, and turned for aid to new and extraordinary resources. He planned and executed one of the boldest manoeuvres of which the annals of history furnish any record. He assigned the command of Syracuse to his brother, transported an army to Africa, burnt his fleet, and ravaged the territory of the Carthaginians to the very walls of their city. After this success he was recalled to Sicily; but during his absence the fortune of war had changed. His army, weakened by desertion and repeated skirmishes, was driven from its strong holds; and the return and exertions of Agathocles left him no hope of retrieving his affairs. Like a celebrated modern leader and usurper, his own personal safety became his only concern in the day of disaster. With a small train of attendants, he retired to Syracuse, and abandoned his army, and even his own family, to the mercy of the enemy. The army, enraged at the baseness of his treachery, murdered his children, and surrendered to the Carthaginians. But Agathocles was not slow in satiating his revenge, for he put to death all the relations of the soldiers whom he could discover; soon after met his own fate by poison, which was secretly administered by the influence of his own grandson; and, after a reign of 28 years, terminated a life stained with cruelty and crime, by a painful death.

AGATHOPHYLLUM, a genus of plants belonging to the class Dodecandria.

AGAVE, or American Aloe, a genus of plants belonging to the class Hexandria.

AGDE, a small town in the department of Herault, in France, is situated on the banks of a river from which the department takes its name, about a mile from its junction with the sea in the gulf of Lyons. The town enjoys some trade, and is a great resort of pilgrims; and the surrounding country, which is a basaltic region, produces fine wool and silk, and is fertile in corn, wine, and oil.

AGE, in its most general acceptation, denotes either the whole period or a portion of the time of the existence of any being. The same term sometimes marks the period of thirty years, and then it seems to be synonymous with *generation*, and sometimes it is equivalent to the period of a hundred years, or a *century*. The duration of the world has been divided by historians into different ages; and the beautiful fiction of the ancient poets, which divides the progressive history of mankind into the ages of gold, silver, brass, and iron, is expressive of the state of innocence and purity, the decline and degeneracy of the human race.

AGEN, a city of the province of Agenois, and in the department of Lot and Garonne in France, contains a population of nearly 11,000, is chiefly remarkable for the venerable remains of Roman antiquity, and is 520 miles south-west from Paris.

AGENOIS, a province of France, forming part of the department of Lot and Garonne. Great part of the valley through which the rivers Lot and Garonne flow, is rich and fertile in corn, wine, and fruits, and the number of inhabitants in the province amounts to 353,000.

AGERATUM, Base Hemp, Agrimony, a genus of plants belonging to the class Syngenesia.

AGESILAUS, king of Sparta, and a celebrated military commander, was born about 444 years before the Christian era, and was raised to the throne in preference to his nephew, the son of an elder brother. The invasion of the Greek cities in Asia by the Persians, roused the Lacedemonians to arm in their own defence, Agesilaus was appointed commander, obtained some signal victories, and finally defeated Tissaphernes, the Persian general. The bravery and success of Agesilaus in this expedition obtained for him the supreme command, by sea and land, from the Spartan government; an extent of authority which no individual had before enjoyed. An interview which took place between Agesilaus and the Persian governor of Phrygia, a person of illustrious rank, presents a striking contrast between the simple manners of the former, and the luxurious habits of the latter. Agesilaus seated himself on the grass, under the shade of a tree, while, with all the pomp of eastern magnificence, rich carpets were spread for the Persian ruler, who, struck with the simplicity of a prince of such distinguished valour, relinquished for a time the splendour of rank, placed himself on the grass by his side, and entered into a close friendship.

Agesilaus was recalled to take the field against the combined forces of the Athenians and Thebans. He was wounded in an engagement on the plains of Cheronæa, and, failing in an attempt on Corinth, ravaged the surrounding country. The wanton acts of aggression in which the Spartans had indulged on their defenceless neighbours, produced a powerful combination against that people; and the Thebans, under their celebrated general Epaminondas, defeated them under the command of Agesilaus, first at the famous battle of Leuctra, and afterwards at Mantinæa.

The last exploit of Agesilaus was an expedition to Egypt, to support a competitor for the throne of that ancient country. Anticipating from the warlike reputation of the Spartan leader, to be gratified with the sight of a person of impressive appearance, the Egyptians were astonished and disappointed to see an old man, of diminutive stature, in a homely garb, sitting on the sea shore. A personal affront which he had received from the competitor whose interests he had first espoused, induced him to throw his influence into the opposite scale; and thus the king of Sparta, a small Grecian state, at the head of his army, became the arbiter of the fate of the mighty kingdom of Egypt. Agesilaus, in his voyage home, was driven into a port on the coast of Africa, where he died, in the 42d year of his reign, and the 84th of his age.

AGGERHUYS, the richest diocese of Norway, has a population which exceeds 215,000 souls, and is the residence of the chief governor of the kingdom. A fortress and city of Norway are also distinguished by the same name.

AGGLUTINANTS, an old term in medicine, applied to such substances as were supposed, according to a justly exploded theory, to have the property of healing wounds, or of uniting separate parts.

AGGREGATE, is a term applied to such flowers as are composed of florets included within the same receptacle or calyx; as dandelion, the common daisy, &c.

AGHRIM, a small village in the county of Galway in Ireland, thirty-two miles distant from Dublin, and celebrated by the total defeat of the army of James II. consisting of 25,000 foot and horse, 7000 of whom, with their general, M. St Ruth, perished on the field of battle, and the army of King William, composed of 18,000 men, under the command of General Ginkle, whose loss is stated at 600 men.

AGIMERE, an extensive region of the East Indies, stretching 5000 miles along the eastern banks of the river Indus, and varying in breadth from 60 to 150 miles. It is divided into different districts; and Agimere, the capital of the country, situated in a delightful valley, encompassed by mountains, is described as six miles in circumference, protected by walls and a strong fortress, and in N. Lat. 26. 24. E. Long. 75. 20.

AGINCOURT, a small village in the French Netherlands, celebrated in history on account of the victory gained in 1415, over the French, by Henry V. of England, who, in support of his claim on the French crown, had conducted an army of 24,000 foot, and 8000 men at arms, to France, and after a desperate resistance, became master of Harfleur; but his army was greatly weakened and diminished in numbers; and having sent back his transports on his first landing, no alternative remained but to march to Calais in the face of an opposing army of 100,000 men. The small band of the English, scarcely amounting to 10,000 men, offered a feeble resistance to such an overwhelming force. Henry, it is said, apprehensive of his critical situation, offered to resign his conquest on condition of being permitted to return to England unmolested. But the French commander, confident of an easy victory, haughtily rejected the proposal. When the English advanced to the village of Agincourt on the 24th of October, the French army was so posted that an engagement was unavoidable. Next morning, by day-light, the battle commenced with a furious onset. The conflict became dreadful, by the desperate valour of the English, and the disorder which soon prevailed in the crowded ranks of the enemy. The French lost 10,000 men on the field of battle, among whom was the Duke d'Alençon, the commander in chief, with many persons of the most illustrious rank; and 14,000 prisoners fell into the hands of the victorious army, of which, it is said, not more than 40 men perished in the engagement.

AGIO, derived from the Italian, and signifying *aid*, is a term used in commerce, to denote the difference between the value of bank money and the current coin. The agio in Holland was formerly at three or four per cent.; at Venice 20 per cent; at Genoa 15 or 16 per cent.; and at Hamburgh 14 per cent.

AGNANO, a lake near Pozzuoli, to the westward of Naples, and about two miles in circumference. The sides and bottom of the cavity of this lake are interspersed with fragments of lava and pumicestone, and it has the shape of an inverted funnel, from which it is inferred that it is the crater or mouth of an extinct volcano. The waters of this lake abound with tenches and frogs, and numerous flocks of ducks swim on its surface.

AGNATE, a term used in law to denote any male relation by the father's side.

AGNES, St. one of the Scilly islands, on the western coast of England; is of small extent, but is well cultivated, and fertile in corn and grass. On the most elevated part of the island, a lighthouse, constructed of stone, and 51 feet in height, is erected. The inhabitants do not exceed 50 families. N. Lat. 49. 56. W. Long. 6. 46.

AGNESI, Maria Gaetana, a lady of extraordinary talents and acquirements, and particularly distinguished by her mathematical learning, was born at Milan in 1718. Her father, a man of some rank, gave every facility to the improvement of a mind, which, from her earliest years, afforded remarkable indications of powerful talents. She made rapid progress in the acquisition of languages. In her ninth year she delivered a Latin oration, before an assembly of learned men, which met at her father's house, to prove that literary studies are not inconsistent with the female character. In her eleventh year, she not only read, but spoke Greek with ease and fluency; she had also acquired some knowledge of the oriental languages, and was quite familiar with French and German. But her studies were

Agnesi. not limited to literature alone. Mathematics, Natural Philosophy, and even metaphysical discussions, fell equally within the grasp of this intellectual prodigy.

While in her 15th year, she maintained *theses* on various subjects of philosophical speculation with the learned persons who at stated times assembled at her father's house, and also occasionally with learned foreigners, discoursing with them in the language in which she was addressed. It is little to be wondered at, that a young lady, in the bloom of youth, of an agreeable person and graceful manners, exhibiting all the profundity of knowledge, acuteness of observation, and power of argument of the maturest and most experienced age, should be the object of universal admiration. For the period of three years she held the most conspicuous place in these philosophical discussions; but she seems to have exercised her wonderful talents in this public manner more to indulge her father's vanity in enjoying the reflected glory of her reputation, than to gratify her own ambition for learned fame. The last splendid display of her argumentative powers took place in 1738, in presence of a numerous assembly of the most illustrious persons for rank and learning, when she finally retired from the field of disputation; and the subjects of extemporary discussions, in which she had been engaged, appeared in a quarto volume, and were published in the same year.

The vigorous mind of Agnesi was now wholly occupied with mathematical studies; and she had not long entered on the pursuit, when she composed a commentary on the Conic Sections of de l'Hospital. But she carried her researches into the higher departments of the science, and afforded ample proof of her profound skill in the doctrine of the modern calculus, by publishing, in 1748, in two 4to volumes, *Analytical Institutions for the Use of the Italian Youth*, a work of great merit, exhibiting a most perspicuous view of the subject, and still regarded as an excellent introduction to the works of the continental mathematicians. This work was translated into English, many years ago, by the late Mr Colson, professor of mathematics at Cambridge. The manuscript was discovered among the papers of the ingenious translator, by the industry of Baron Maseres, in 1801, through whose liberality it was presented to the world. This remarkable production procured for its author the honour of being elected a member of the Institute of Sciences at Bologna, and the distinguished nomination of Professor of Mathematics and Natural Philosophy in that university; an appointment which she received from the Pope. A doubt has been expressed, whether she ever entered on the active duties of the professorship; but it seems probable that it was altogether intended as an honorary mark of distinction. We are gravely told, indeed, by some of the biographers of this wonderful lady, that female professors were by no means uncommon in Italy; and one, throwing aside all the delicacy of the sex, filled the anatomical chair in the same university. The most careful inquiry, we suspect, could produce but a scanty list of female teachers; and of such professors as Agnesi, she yet remains, perhaps, a solitary instance.

Agnus || Agra.

But the well-merited honours of learned reputation faded before her; worldly distinctions lost their charms; and the desire to spend her remaining years in the exercises of devotion, induced her to retire to the gloom of a convent. She became a member of the order of Blue Nuns; exchanged the pursuits of abstract science for the study of the scriptures in the original tongue, and the ancient fathers of the church; and lived in such rigid seclusion, that the most urgent solicitations of learned foreigners, to see and converse with so extraordinary a person, were altogether fruitless. The last 40 years of her long life were devoted to religious retirement; and she died in 1799, at the age of eighty.

In the opinion of certain critics, this lady affords a striking vindication of the intellectual capacity of her sex, and an ample refutation of the degrading notion of the inferiority of the female mind. But it seems to be forgotten, that such extraordinary endowments and splendid attainments are of rare occurrence; and with all the advantages of education, the talents and acquirements of Agnesi are but seldom equalled even among the other sex. The comprehensive genius of Newton is not to be considered as the common measure of mental perfection; and perhaps the only parallel of the Italian female philosopher, recorded in history, is Hypatia, of Alexandria, who lived in the 4th century, and who, it is curious to observe, was also a mathematician, a commentator, and a professor. But although we do not allege that the female mind is unequal to scientific researches, nor do we assert that they are inconsistent with the female character, yet it may be fairly doubted whether such avocations be at all compatible with the domestic duties of wives or mothers.

AGNUS DEI, or *Lamb of God*, is a cake of wax, on which is impressed the figure of a lamb supporting the banner of the cross. This cake, having received the Pope's consecration, is distributed to the people, who ascribe to it numerous virtues, and believe that those who have it in their possession are protected from evil and prompted to do good.

AGOWS, a people of Abyssinia, who, although possessing a country abounding in the necessaries of life, are reduced by oppressive burdens to great poverty and wretchedness. The Agows seem to be a pastoral people; the care of their cattle, and the management of bees for the honey and wax, are their chief occupations. Hides, tanned in a peculiar manner, constitute their only dress; and in religion, manners, and customs, they approach nearly to the other nations of Abyssinia.

AGRA, a very extensive province of Hindostan, having Delhi on its northern boundary, and the province of Oude on the east. The productions of Agra are, rice, cotton, and indigo, which is esteemed the best in the east, with all the fine fruits of tropical climates; and its chief manufactures are muslins, silk stuffs, and gold and silver lace. The revenue of this province exceeds 16,000,000 rupees; and its military force is composed of nearly 600,000 infantry, 50,000 cavalry, and more than 200 elephants.

AGRA, the capital of the province of the same name in Hindostan, is situated on the river Jumnah, 300 miles to the eastward of Surat. Agra became the seat of empire in the time of Akbar. From an inconsiderable place, it gradually rose to wealth and splendour; and towards the close of the long reigns of that emperor, and of his son and successor, it was justly regarded as the most magnificent city in the east. The city is built in the form of a crescent, and surrounded by a stone wall, and a ditch of a hundred feet wide. The streets are narrow and irregular, with low and mean houses; but the palace and castle are remarkable edifices for extent and grandeur. The palace, which was erected at an expence of three millions of rupees, and employed a thousand men for twelve years, is situated within the castle, contains three courts, is encompassed with splendid porticoes and galleries, finely painted and gilt, and affords accommodation to the imperial guards and their officers. The spacious and magnificent apartments of the emperor and his seraglio appear in the third court of this vast structure. The grandeur and magnificence of Agra are increased by eight hundred public baths, sixty caravanserays or lodging-houses, and numerous mosques and sepulchral monuments, among which the mausoleum of Akbar is not the least conspicuous, as well as another erected to an empress, which cost £75,000 Sterling. N. Lat. 27. 15. E. Long. 78. 29.

AGRARIAN LAWS, from a word which signifies a field, are those laws which were enacted at Rome to regulate the division of the conquered lands, and to limit the extent to be held by each person. The most celebrated of these laws was promulgated by Spurius Cassius, about the year of Rome 268. Many laws of this description were passed at different periods, and they referred to the partition not only of the territory taken from the enemy, but also of lands purchased with the public money, or of such as had been usurped by powerful individuals. Many of the attempts to introduce and establish Agrarian laws excited, as might be expected, great dissension between the Roman people and their magistrates, and frequently terminated in violent commotions.

AGRICOLA, Cneius Julius, one of the most celebrated of the Roman generals who conducted the war in Britain, and contributed to its subjugation to the Roman power, was born in the year 40, in Provence, studied philosophy and law at Marseilles, and afterwards served in a subordinate capacity in the Roman armies in Britain. His return to Rome was immediately succeeded by an appointment to the quæstorship of Asia, during which his conduct was greatly distinguished by honour and integrity. Agricola supported Vespasian when he assumed the imperial power and dignity, was himself raised to patrician rank, and was appointed governor of Aquitania. After the lapse of three years he returned to Rome, and was admitted to the consulship along with Domitian, and in the year 78 was elevated to the important station of governor of Britain; and in the affairs of this country, the prudence, address, and vigour of Agricola's administration were soon highly conspicuous. Having suppressed several revolts, and terminated successfully different campaigns in which he had engaged, he wisely attempted, by conciliatory measures, to secure the conquests which he had made; and the schemes which he proposed to a certain extent succeeded. Civilization made some progress among the Britons. They adopted the customs, imitated the manners, assumed the dress, and studied the language of the Romans. The cessation of hostilities was favourable to the arts; and during this period of tranquillity, many of the splendid works of the Romans in Britain were erected. Baths, temples, and other magnificent edifices arose, to adorn the rugged aspect of the country. But this was only a temporary calm; the Britons were yet unacquainted with peaceful habits, or their love of liberty and independence would not suffer them to submit quietly to a foreign yoke; and Agricola resuming offensive operations, proceeded northward in his career of victory.

In the third campaign in Britain he advanced to the river Tweed; in the next he subdued the whole region between the Tweed and the Forth; and in the fifth he crossed the Forth, and carried his victorious arms into countries hitherto unknown to the Romans. Having proceeded beyond the Tay in his sixth campaign, in the following spring he advanced with an army of 11,000 men towards the Grampian mountains, to attack the Caledonians, amounting to 30,000, under Galgacus, an able general. The battle was severe and bloody; and the Caledonians, after leaving 10,000 dead on the field, were completely routed, and their country was reduced to a desolate waste.

Domitian, who had now attained the sovereignty of the empire, although he encouraged the triumph which was decreed to Agricola, and ordered a statue to be erected to his honour, on account of the splendid acquisitions which he had made to the Roman territory, became jealous of his glory and popularity, and recalled him from Britain, under the false promise of promotion to the government of Syria. But the promise was studiously evaded; and Agricola was no longer permitted to hold any place of trust and authority. He died soon after his retirement from public life; and his death was ascribed to poison, administered, according to a prevailing suspicion, at the instigation of the emperor. Tacitus, the celebrated historian, who married the daughter of Agricola, has transmitted to posterity a highly interesting biographical sketch of his father-in-law; and while classical taste remains, and elegant composition is admired, the memory of Agricola will not be forgotten. The glow of affection which his virtues excited while living, and the tender effusions of mournful regret occasioned by his death, have produced one of the finest specimens of pathetic expression.

Agricola, George, a physician and mineralogist, was born at Glauchen, in Meissen, or Misnia, in Germany, in 1494, received his medical education in Italy, and entered on the practice of his profession in his native country. Accompanying the train of some German princes in the expedition of Charles V. into Bohemia, he seems to have imbibed a strong desire to acquire a knowledge of minerals and metallurgical operations, which continued to be his favourite pursuit, and afterwards his sole study, through life. Having relinquished the medical pro-

Agricola.

fession, he removed to the celebrated mining district of Chemnitz, where he not only devoted his whole attention to the prosecution of mineralogy, but spent his patrimonial property, as well as the pension which he enjoyed from the German princes, in the ardent pursuit of the same object. Agricola is generally supposed to be the first German author who professedly wrote on minerals; and his works on this and kindred subjects are not destitute of elegance and ease of expression. His writings, composed in Latin, treat of the *Origin and Causes of Subterranean Matters;* of the *Nature of Fossils;* of *Mineral Springs;* of *Metallic Matters,* &c.

At one period of his life, it is said, Agricola was inclined to the Protestant religion; but he died steady in the faith of the church of Rome. His death happened at Chemnitz in 1555; and so violent was the bigotry of the Lutherans, against whom it was alleged he had at one time uttered severe censures, that his body remained unburied for five days. It was afterwards removed to Zeits, and consigned to the grave in the principal church.

AGRICULTURE.

Introduction

AGRICULTURE, in its strict acceptation, signifies the cultivation of the ground, for the improvement and increased production of such vegetables as are employed directly for the support of man, or for the nourishment of those animals which are destined for the purpose of food or domestic labour; but, in a more enlarged sense, it includes the whole business of *Husbandry,* or whatever is connected with *Rural Economy.*

The principles of agriculture and gardening may be regarded as nearly the same. The object of both is the culture of certain vegetable productions in the greatest abundance and in the utmost perfection of which they are susceptible. But the former proceeds on a large scale, and is employed in rearing plants of a hardy nature, while the latter is occupied with the cultivation of more delicate vegetables, which require more minute attention and nicer management. The industry and ingenuity of the Chinese, in their more populous provinces, where land is greatly subdivided and held in small possessions, have carried agriculture to a state of perfection which is not far distant from that of gardening in some other countries.

To prove the importance of husbandry, it is scarcely necessary to refer to ancient nations, who ascribed divine honours to those to whom they conceived themselves indebted for the invention or discovery of different branches of the art. The kings of ancient Persia, once every month, laid aside the pomp and grandeur of state, and relinquishing the luxurious banquet to partake of the simple fare of the husbandman, afforded a striking expression of the high estimation in which it was held by that people; and, in modern times, a practice somewhat similar prevails among the Chinese; the monarch, as it were, divests himself of his imperial dignity, condescends annually, in the commencement of spring, to put his hand to the plough, and offers a solemn sacrifice to secure a favourable season and an abundant crop.

With that prepossession which a favourite subject on which the mind has long dwelt usually inspires, some writers who have assigned to agriculture an extraordinary pre-eminence over other arts, seem to have left altogether out of view the intimate connection and mutual relation which subsist among all the branches of human industry. Without the aid of mechanical ingenuity, what progress could agriculture make towards improvement? Without the plough and the spade, the operations of the husbandman would be clumsy and awkward. Mechanical contrivances are not less essential to the successful advancement of agriculture, than bread-corn is a necessary requisite to the manufacturer and artizan. It is needless to dilate on this topic; a very slight consideration must render it obvious, that the arts of life are not to be contemplated in an independent or insulated state, for they mutually cherish and support each other. No profession could be long exercised without its proper objects. The labours of the husbandman would soon cease, if the productions of the soil found no market, or could not be commuted with the industry of those engaged in the multiplied processes of arts and manufactures. But laying aside this fancied rank, this presumed antiquity and preference, when the profession of husbandry has attained some degree of perfection, such as it exists in Britain at the present day, if we consider the extent of intelligence, the varied knowledge, the accurate discrimination, the unwearied industry, the minute details, and the economical management which its successful practice requires, it cannot fail to occupy a high place in our estimation.

History.

We shall not attempt to trace the history of agriculture among ancient nations. The works of Hesiod and Xenophon on the husbandry of the Greeks are yet extant; various Roman authors, as Cato, Varro, Columella, Pliny, and others, have treated largely of the same subject; and none, who is at all acquainted with classical literature, can be ignorant that the beautiful poem, the Georgics of Virgil, is devoted to the illustration of the different branches of rural economy. Aware of the importance of agriculture in a state, the Romans were greatly distinguished by their knowledge and industry in this pursuit; and it is not a little curious to remark, that modern husbandry has added only two plants, the potatoe and buck-wheat, to the number of species, amounting to forty or forty-three, which were cultivated by that people.

The state of agriculture in Britain, previously to the Roman invasion, was extremely rude. But as the Romans never neglected to introduce their own improvements into the countries which became subject to their dominion, the agriculture of Britain flourished greatly under their knowledge and experience of the art; and the produce of corn was so abundant, that large quantities were exported. It is said that

History.

800 vessels, each supposed equal to 300 quarters, were employed in the export trade of corn.

The progress of agricultural improvement in Britain was interrupted by the inroads of the Saxons, a rude people, and chiefly devoted to a pastoral life. The native inhabitants were driven from the lowlands, and took refuge in the mountainous districts of Wales. But the limited possessions and increasing population of the new settlers, required them also to direct their attention to tillage, for the purpose of raising corn. The Norman conquest, in the year 1066, proved another serious interruption to the progress of agriculture as it existed in Britain at that period. The invaders introduced their own husbandry; and it appears, from the description of William of Malmsbury, that the vine was successfully cultivated, and extensive vineyards established in the vale of Gloucester, from which wine little inferior to the wines of France was produced.

In several succeeding centuries, the numerous religious houses which arose in this country were richly endowed by pious donations, and acquired those vast possessions, which included many of the most fertile spots in the kingdom. With whatever indolence and luxury the monkish proprietors may be charged, they were not inattentive to husbandry. They introduced and cultivated some of the best fruits, planted the finest orchards, the remains of some of which are objects of admiration at the present day, and, with great humanity and moderation, exercised a paternal care over their farmers and tenants, altogether worthy of patriarchal times.

Agriculture was greatly interrupted and depressed during the severe struggle for power between the houses of York and Lancaster which deluged England with the blood of her citizens. It revived in the time of Henry VIII., and the first English writer on this subject appeared in his reign. This was Fitzherbert, one of the judges of the court of Common Pleas, who published, in 1534, *The Book of Husbandry;* and, in 1539, *The Book of Surveying and Improvements.* In some succeeding reigns it was checked by injudicious and oppressive laws. But it was encouraged and promoted during the Protectorship of Cromwell; and the writings of Gabriel Plattes and Walter Blythe seemed to have contributed not a little to its improvement. About the same period Samuel Hartlib, the friend and contemporary of Milton, appeared as a writer on agriculture; and the hint thrown out in the preface to his work, entitled the *Legacy*, in which he regrets the want of a public establishment for the improvement of husbandry, procured for him, it is said, a pension of L. 100 a-year from the Protector.

The writings of Evelyn on *Earth*, or Soil, and *Plantations*, subjects closely allied to agriculture, contributed to its improvement; and the celebrated work, published in 1713, by Jethro Tull, the father of the horse-hoed or drill-husbandry, forms a remarkable era in its progress, and confers a singular benefit on the art by the introduction of so valuable a practice, although the author carried his speculations much too far when he fancied that his system would supersede the application of fertilizing substances, or the use of manures to an exhausted soil.

History.

The dawn of still higher degrees of agricultural improvement in Britain, began to appear about the commencement, but its brighter day did not break forth till towards the close of the eighteenth century. During this period, the spirited exertions of some of the first noblemen and gentlemen, who had formed themselves into a society for the advancement of internal economy, introduced a better system of husbandry in many districts of the northern part of the kingdom; under the fostering care of the Dublin society, a powerful, liberal, and enlightened body, the state of rural economy has been greatly meliorated in Ireland, whose genial climate and rich soil are peculiarly favourable to every judicious improvement in husbandry; and the British Board of Agriculture, established about 1794, by the zeal and patriotism of Sir John Sinclair, baronet, has been the means of amassing a most valuable collection of information on all branches of rural affairs from every district of the United Kingdom.

The institution of the agricultural professorship in the university of Edinburgh, and the fortunate appointment of Dr Coventry, whose numerous scientific acquirements so eminently qualify him to fill that chair, may be regarded as an important era in the history of the rural economy of this country. With the happy talent of deducing, from extensive and accurate observation, precise and rational rules of practice, that enlightened professor, not only by his valuable public lectures, but also by the judicious system of management in every department of husbandry, which, at his suggestion and recommendation, have been adopted by individuals, must soon have the high gratification of witnessing the beneficial effects of his excellent instructions rapidly and widely diffused throughout the nation.

In closing this historical view of the progress of agriculture, we must not omit noticing the writings of Anderson, Young, Marshall, the numerous reports of its present state in counties and districts, chiefly drawn up by intelligent practical farmers, and the essential services which they have contributed to its improvement in their ample illustrations of its various branches; and also the provincial societies, of which scarcely a district of the kingdom is without one, by whose influence, in the frequent communications among the members themselves, and the occasional publication of memoirs, read and discussed at their stated meetings, in different periodical works, agricultural knowledge has been in no small degree promoted. A liberal spirit of communication is a distinguishing feature in the character of the British agriculturist. No concealment, no secrecy, no mystery, as in other arts, appears in his profession. With the most unreserved confidence, he submits all his plans, and operations, and discoveries, however beneficial to himself, to the inspection and examination of his countrymen, and, with the most laudable zeal, he hastens to make them known to the world.

Objects of Agriculture.—We have already hinted at the variety of information requisite for the successful practice of agriculture. An accurate knowledge of the climate, including the variations of temperature and pressure of the atmosphere, the prevailing winds, the quantity of dew, rain, and snow, and the changes of the seasons, may often regulate the proper branch of husbandry which is adapted to particular situations. This kind of knowledge is undoubtedly of great importance, and merits the attentive consideration of husbandmen. But as the method of observing and recording these phenomena, will be fully treated under METEOROLOGY, we must avoid repetition, and omit it in this place. The objects which come under discussion in a system of agriculture, may be enumerated under the heads of Draining—Inclosures—Soils—Manures—Implements of Husbandry—Tillage—Grass-lands—Live-stock; and topics of a miscellaneous nature—as the accommodation in Dwelling-houses and Offices—Leases—Rent.

CHAP. I. OF DRAINING.

To whatever purpose land is destined, whether for tillage or pasture, when water, as it falls in the form of rain and collects on the surface, or as it arises from springs in the bowels of the earth, stagnates upon it for any length of time, it becomes comparatively of little value. Even the temporary stagnation of water on arable land may interrupt the necessary operations of tillage in their proper season, and occasion a scanty crop and a precarious harvest; while it may give rise to those diseases which are induced by a wet soil and a moist atmosphere. The produce of grass lands, also, in which water is redundant, is herbage of a coarser and hardier kind; hence it must appear, that draining is the first and one of the most important improvements in husbandry: The processes for the management of arable lands are rendered more seasonable and certain, the herbage crops change their character and afford more nourishing pasture, and the climate itself is essentially improved.

SECT. I. *Of Surface Draining.*

The drainage of fields, or inclosures of moderate size, is effected by means of the ordinary furrows which are formed in the operations of tillage; and the ditches which usually surround such inclosures, and receive the superabundant water from the furrows, are the main drains. In subdividing and inclosing land, this important object should be always kept in view; for the limits may be fixed in such a way, as at the same time to accomplish the valuable purpose of draining. But in extensive flats which are covered with water during the whole or great part of the year, a more expensive operation is required. A main drain conducted from the intended outlet, must be formed with such a slope, and of such a depth, as shall be sufficient to relieve the soil from all redundant water. The course of a drain of this description, when the inclination of the ground is not perceptible, is found by the ordinary process of levelling, and in most cases by the use of the spirit-level alone. But, without any instrument, those who are familiar with practical draining, can discover the declivity of the ground and the course of the water, even in land which seems nearly flat, by examining the ditches when they are almost dry in summer, and by observing to what point the leaves of aquatic plants are directed. When the extent of land to be freed from water is considerable, a single drain is seldom sufficient; branches from different parts of the field uniting with the main drain are necessary; and the number and direction of these branches must be determined by the extent and inequalities of the surface. The subordinate drains or branches should form the junction with the main drain in the direction of the current, to avoid the danger of sand or earth accumulating and forming obstructions when they enter it transversely.

The declivity of the ground in many cases regulates the slope of drains; but where the outlet and other circumstances afford an opportunity of marking its limits, it should neither, on the one hand, be too great, when the sides and bottom, exposed to the rapidity of the current, are apt to be injured, and to require frequent and expensive repairs, nor, on the other hand, should the inclination of the drain be too small, by which the current becomes sluggish and stagnant, and the land is not fully relieved from water.

No precise rules can be laid down for the dimensions of open drains, as they must be varied according to the nature of the soil, the situation, and the quantity of water to be carried off. The width at the bottom of the drain must be regulated by the proportion of water to be discharged; and it may be stated as a general rule, that the width at top should be at least three times greater than the bottom, to admit of sufficient slope and solidity to the sides. But in soft and mossy soils a greater slope is requisite; and when the drain is not proposed to be a fence as well as a sewer for conveying the water, the earthy matters thrown out should not be left on the sides to form an elevated bank, but spread on the field, or removed. In soft marshy grounds, where the drain is also required to be a fence, the bank of earth, which should always be thrown out on the lower side, may be allowed to remain, and a small parallel cut may be opened to receive the surface-water from that side, and to conduct it to a convenient place, where it may be admitted into the larger drain.

Wherever there is much risk of surface-water being greatly increased in the time of rain or floods, open drains must always be preferred, to avoid the danger of being entirely obstructed, to which covered drains are liable. But as such drains, constructed in the usual way, would disfigure an improved field, and interrupt tillage operations, they ought to have a greater slope, and a green sward should be permitted to form on their sides. If the direction of the ridges be parallel to the drain, the cultivation of the field is uninterrupted; and when it is in pasture, it presents no obstacle to the free passage of cattle. But it ought to be observed, that whatever be the slope of such drains, the sides should never be ploughed; for any increased flow of water would carry off the loosened soil.

Surface-water is removed from lawns and smooth sheep pastures by means of a simple operation with a strong common plough. Let a deep furrow be turned up through the hollow parts of the field where water stagnates, pare off the earth from the inverted sod, leaving it about three inches thick, and return it to its natural position. In this way a small hollow drain of three or four inches is left in the bottom of the furrow, which is found sufficient to discharge a considerable quantity of water. By this easy process, a great extent of drain can be executed in a short time; and when any part is obstructed, it can be repaired at a small expense. The earth which is pared off may be removed to hollow parts of the field, or spread on the ground.

Lands which are appropriated to woods or plantations of any kind, derive no less benefit from draining than what is destined to corn or herbage crops. For this purpose, open or surface drains are the most suitable: for, in covered drains, the roots of the trees and underwood, stretching along horizontally, insinuate themselves among the stones, and thus interrupt, and at last entirely obstruct, the passage of the water.

Draining stiff, flat Soils.—In many cases, where the surface is flat, and the soil of a stiff and retentive nature, attempts to dry the ground by means of covered drains are found to be ineffectual. In most of the central counties of England, and in the flat land of Flanders, the land is relieved from surface-water by forming high and broad ridges of twenty, thirty, and even forty feet wide, and having the crown three and sometimes four feet higher than the bottom of the furrows. The beneficial effects of this method of draining are fully confirmed by the successful practice of the Flemings; for when furrows are kept free from water, the land is always dry, and the crop healthy and abundant. But in some parts of England, from the improper direction and flatness of the ridges, and the shallowness of the furrows, these good effects have not been obtained; for the water, stagnated in all the hollow places, renders those parts of the field useless, has even brought some degree of discredit on the method itself, and has led to the adoption of other less perfect methods of draining. The indiscriminate formation of high ridges has been justly censured. On a dry, loamy soil, they are altogether unnecessary; but when they are well rounded, not too much elevated, and the furrows kept clear, they afford the best and most efficacious method of rendering land of a retentive surface perfectly dry.

In some cases, from the peculiar nature of the soil, the practice of combining open and hollow drains has been found extremely beneficial. The following is the method adopted by Mr Goade of Cossington, in Leicestershire. The soil on which he operated is sandy on the surface, from six to ten inches deep, red clay at the bottom, and in some places gravel, from which the water is thrown upon the surface of the land. Finding it difficult to drain the soil, he formed hollow drains in the furrows. The ridges are from five to ten yards broad, aud varying in height, being raised, for summer corn, only six inches, but for winter crops twelve inches at the crown, above the bottom of the furrows. In turf ground, the hollow drains are dug fifteen inches wide, and two feet deep, sloping downwards. The turf is first cut out, and with another implement, which is seven inches wide at the top, and becoming narrower to the length of sixteen inches, the other materials, whether sand, gravel, or clay, are thrown out. When the bottom of the drain is of clay, it is cut four inches deeper in the middle, and only four inches wide, leaving two inches on each side, or what are called *shoulders*, to support the turf, which is laid flat upon it, with the grass side downwards. The upper part of the cavity is then filled up. When the land is of a mixed soil, thorns, or elder boughs, are laid, and trodden down in the drain; after which the turf is laid upon them as before, and close to the sides of the drain: but where slate, or thin slabs of stone can be obtained, the construction is more solid, and the operation more complete. In clearing out the bottom of the drain, which is about four inches wide, an instrument somewhat resembling a hoe, of the form of the letter L, and half rounded at the lower end, is employed. Drains of this description have operated for fifteen years without interruption, and even when filled with bushes; it is expected that they will continue uninjured for a much longer period; and it is added, that the improvement ought not to be estimated at less than one-fourth increase of the crop.

The method of relieving a retentive soil from water, by means of surface-draining, as it is practised in the Carse of Gowrie, in Perthshire in Scotland, and described by Mr Paterson of Castle-Huntly, is also worthy of notice. This simple operation is the only means which is employed in draining that extensive flat. Large common drains, traversing the district in different directions, and of sufficient capacity to receive the water conducted from the fields by the surrounding ditches, discharge their collected waters into the river Tay. Every farm is surrounded or traversed by ditches, as may suit the particular situation, all of which are so directed and arranged as to form a communication with every field on the possession. The breadth of these ditches is from two to four feet at top, and from a foot to a foot and half at bottom, and with such a slope as to prevent their sides from falling in. If the fields be of an uniform level surface, the common furrows between the ridges, with sufficient depth at their extremities, serve to carry off the redundant water; but in a field of unequal surface, the last operation, after the sowing and harrowing are completed, is to draw a furrow with the plough through all the hollows which lie in such a direction that it can be guided through them, and thus form a free communication with any of the furrows between the ridges, which latter are conductors of the water to the surrounding ditches. When this furrow is formed by the plough, it is widened, cleared out, and dressed with the spade, that the risk of filling up may be avoided. The width is from six inches to a foot, according to the depth; but the breadth of a spade at bottom is generally found sufficient. It often happens that inequalities, or hollows, do not extend across the field, or pass through it in any direction to be followed by a plough, but are limited to one or two ridges. In such cases, the furrow is to be made by the spade, and the communication formed with the nearest furrow in the vicinity.

In the Carse of Gowrie, it is yet the general practice to have head ridges at the extremities of each field. These transverse ridges, on which the plough turns, are higher in the middle, and fall off at each side; and the inner furrow, communicating with all the furrows of the longitudinal ridges, receives all

Draining.

their surface-water, and discharges it by an open drain, cut through the head or transverse ridge, into the adjoining ditches. But the same writer observes, that the surface-water passes off more freely, and the drain is more perfect, when no transverse or head ridge is formed; and this method Mr Paterson has successfully followed on all the fields which he has levelled. To avoid these head ridges, he lays up the earth uniformly to the ends of the longitudinal ridges; and this, although with a little more trouble, is easily effected, by returning with an empty plough. In this way, there is no depression between the longitudinal and tranverse ridges, but the longitudinal furrow is carried fairly through the head ridge. Besides this management, it is found by ample experience, in this rich district, that by careful ploughing, laying up the land equally, and rounding the ridges properly, so that they are neither too high nor too low, all the surface-water is easily removed; and while the crowns are neither too much enriched, nor the furrows impoverished, the whole becomes equally dry and fertile, and is frequently earlier accessible to the plough in the spring than more elevated grounds in the vicinity.

Sect. II. *Of Under-ground Draining.*

The wetness of land, it has been already remarked, arises, either from rainwater collecting in hollow places on the surface, or from the water of springs, forced up from below; and it is easy to discover from which of these causes the moisture proceeds, by the nature of the plants which are produced on the wet soil. When the land is kept in a soft and spongy state by surface-water, that species of rush known by the name of *spret*, *(juncus articulatus, Linn.)* grows up in abundance; but the common rush *(juncus conglomeratus, Linn.)* appearing in hollows or the sides of declivities, affords a sure indication of the soil being drenched with water rising from below. The method of drying the soil in the latter case, which is one of the most essential improvements of which modern agriculture can boast, depends on an accurate knowledge of the distribution of the strata, and of the circulation of water in the bowels of the earth, or of the nature and origin of springs.

Origin of springs.—The water which falls from the clouds, in the form of rain or snow, to the earth, partly returns to the atmosphere by the process of evaporation; partly flows from the higher to the lower grounds, to form rivers; and partly sinks into the soil, and passes through various kinds of strata, to give origin to springs. If, in going downwards, a bed of gravel or sand succeed to a loamy or sandy-surface soil, and repose on a stratum of clay, the rain-water immediately filtrates through the open soil, and accumulates in the sand or gravel; for its passage is interrupted by the bed of clay. If one extremity of this bed of gravel or sand be more elevated than the other, a pit, dug in the lower extremity, is soon filled with water; and, according to the difference of elevation, may rise to the surface, or overflow. When the extent of surface from which a bed of gravel, or any other porous stratum, is supplied with rain-water, is considerable, the springs are perennial; when of smaller extent, the flow of water ceases during the dry season; and, when still more limited, the springs yield water only in the time of heavy rains.

Draining.

The materials of which the earth is composed, as far as human research has extended, are very different with regard to the property of retaining water, or of allowing it to pass freely through them. Great diversity, in this respect, prevails in the soil, or immediate covering of the earth, in which vegetables grow; and hence soils are characterised as wet and dry according as they are more or less retentive or porous. A stiff, clay soil, which allows no water to pass through it, and a sandy soil which retains none, may be regarded as the extremes in the description of wet and dry soils. A similar diversity is observed in the under stratum or subsoil, as it happens to be clay, gravel, or sand, as well as in the strata of solid rocks. Beds of clay, or of gravel and clay, argillaceous rocks in general, and rocks in which there are few fissures or openings, retard, or entirely interrupt the progress of water through them. But strata of gravel and sand, sandstone, basaltic or whinstone rocks, calcareous rocks, as chalk beds, different varieties of limestone and marl, from their absorbent or porous nature, or from the fissures or caverns which abound in some of them, readily receive water, and often as freely allow it to escape. The whole art of draining, according to the new method, depends on a precise knowledge of these materials, whether they refer to the soil and subsoil, the alluvial strata, or the solid rocks, and of their mode of distribution and relative position.

The first thing to be considered in draining land is the source of the wetness; whether it be surface-water, which, from some obstruction, is not permitted to pass off freely, or water thrown up from some of the inferior strata. If a hollow piece of ground be covered with water, or if it should be only wet and spongy during great part of the year, and even during the dry season; and when this ground has been for some time retained in pasture, if the common rush begin to shoot up and thrive on the edges of the wet spot, where the soil is somewhat more solid, and if it stretch upwards on the sides of the declivity, or more particularly to a greater height on one side,—then the conclusion is pretty certain that the water proceeds from the underground strata, from a bed of gravel, or other porous matter, at some depth under the surface, and supported by an impervious stratum, as a bed of clay. But the certainty of this conclusion can be easily put to the test by a simple experiment. If a pit be dug at the upper edge of the space occupied by the rushes, to the depth of two or three feet, which must vary according to the thickness of the different strata and the depth of the porous bed through which the water filtrates as soon as the latter stratum is penetrated, the water rises in the pit, and perhaps in a short time overflows and runs along the surface. But if a cut, of sufficient dimensions to convey the whole of the water to the nearest ditch, be made, it is probable the wet ground will be relieved from the water, the rushes will disappear, and plants of a very different character take their place. In case no water should appear in the pit, after digging to a mederate depth, or if it should not be convenient to penetrate deeper than one foot and a half or two feet, recourse may be had to the borer or auger, an instrument employed for this purpose, to form a communication with the porous stratum containing the water, to the depth of many feet or fathoms. When the borer reaches the porous stratum, and is withdrawn, those who witness this interesting and beautiful experiment, will be gratified with seeing the water burst up with considerable force, and soon fill the pit; and if the communication thus formed continue uninterrupted, the ground becomes dry, and is rendered fit for all the purposes of tillage. The cause of the wetness at the place where it appears is easily explained: The water accumulates in the porous stratum, increases the pressure on all sides, and having burst the upper covering, forces a passage for itself, and oozes through the soil along the declivity, and, when the spring is copious, collects in the hollow ground, and forms a marsh. This operation, however simple and obvious it may appear, now that it is well known and distinctly understood, must always be regarded as one of the most beneficial agricultural improvements, because it is the foundation of every other; and if it must be less ascribed to accident than to observation and reasoning, the merit of the successful discoverer has not yet been sufficiently appreciated.

Discovery of tapping springs.—Two competitors have appeared, claiming the merit of this valuable discovery; and, after all that has been said and written on the controversy, it is difficult to say to whom the claim of priority ought to be allowed. Dr James Anderson, so well known for his numerous writings on rural affairs, published essays in 1775, in which he gives a full and clear statement of the nature and effects of the operations which he practised on his own property in Aberdeenshire in the year 1764. The first published account of Mr Elkington's claim to the merit of the discovery, appeared in an excellent work on draining, by Mr Johnstone, surveyor, who, in 1796, had visited Mr Elkington, and accompanied him in an extensive tour through different parts of England to see and examine the effects of his new system. According to the account of the origin and progress of his operations, given in the work just alluded to, Mr Elkington was left by his father in possession of the farm of Princethorpe, in Warwickshire, in the year 1763. The poverty and wetness of the soil occasioned the rot among his sheep, and several hundreds perished. This severe loss naturally led him to attempt to obviate the cause, by draining his grounds; and in the succeeding year (1764) he commenced his first operation on a clay-soil, approaching nearly to the state of a swamp or shaking-bog, in consequence of the water discharged from the springs of the contiguous bank of gravel and sand, and overflowing the low ground. For the purpose of draining this field, he cut a trench, four or five feet deep, a little below the upper side of the bog, where the wetness first appeared. Proceeding in the same direction, and at the same depth, he was disappointed in his expectation of reaching the reservoir from which he suspected the water arose. A servant came to the field at this time with an iron crow or bar for another purpose. Mr Elkington, thinking the trench too shallow, or wishing to examine the nature of the strata below, took the iron bar, forced it to the depth of four feet below the bottom of the drain, and was not a little astonished to see a great quantity of water burst up through the opening, and run along in a copious current. Thus, it is said, chance was the parent of a discovery, which led Mr Elkington to the knowledge, that wetness of the soil is often produced by water proceeding from a greater depth than any drain can reach; and also led him to the use of the auger, a most valuable instrument in the operation of draining. Mr Elkington not only succeeded in relieving his own farm from water, and producing sound pasture, but became a professed drainer; and, after the lapse of more than thirty years, had the good fortune to receive a reward of L.1000 Sterling from the British parliament for his discovery.

Principles of the new system.—The principles of draining, according to this mode, are few, and extremely simple. Three circumstances require to be attended to: 1st, The discovery of the main spring; 2d, The determination of the course and inclination of the strata; and, 3d, The use of the auger, in cases where the spring is beyond the reach of the ordinary depth of a drain.

In proceeding, according to this method of draining, the neighbouring high grounds are to be examined, to ascertain precisely the nature, composition, and inclination of the strata, and their relative position with the ground to be drained; from which an opinion can be formed of the nearest point where the water may be cut off and discharged by the level of the spring. To obtain this necessary information, the beds of the nearest streams, the face of steep banks, pits, wells, and quarries, are to be minutely surveyed. Having discovered the main spring, the next object is to determine accurately the line of level in which the drain is to be conducted. This is one of the most important parts of the operation, and requires particular attention. The last part of the operation is the application of the auger, which is employed in all cases where the outlet, or the expense, or difficulty of execution, does not admit the drain to be cut so deep as to reach the spring.

Spring bogs.—The application of the principles now laid down, will not, we apprehend, be difficult, when all the circumstances are fully considered. Suppose there is an extensive flat of swampy land, lying on the bank of a river, and from the examination of the appearances, it is concluded that the supply of water is derived from numerous springs, indications of which are distinctly observed on the declivity of the adjoining elevated bank, which forms the boundary of the bog on one side; and suppose, first, that all the springs arise along the upper edge of the wet ground,—then it will be found, that a single drain, conducted in the direction of these springs, will effectually carry off the redundant water. But let it be supposed farther, that on examining the surface from which the springs issue, they appear at different levels, that the upper series of springs is exhausted in the dry season, while those in the lower part of the declivity continue to flow, the conclusion in this

Draining. case is pretty certain, that the whole springs are derived from the same source. The lowest are to be considered as the main springs, and the line of the drain is to be conducted in their direction, by which the supply of water is completely intercepted. If the drain were carried in the direction of the upper line of springs, it would also answer the purpose, but it would require deeper cutting, and therefore a greater expence would be incurred; or the use of the auger might be required, which is superseded by the first method in such cases. It is scarcely necessary to add, that extensive bogs or swamps may require subsidiary trenches in different places, to carry off the whole of the water.

Drainage of hills.—The irregular distribution of the strata of which hills are composed, frequently produces alternate portions of wet and dry ground on the surface. The general aspect of the ground, the nature of the plants, and the degree of wetness which prevails, may often indicate the kind and arrangement of the strata, as well as the proper direction of the drain. When the rock is horizontal, or is only slightly inclined, all the springs may derive their waters from the same source, and this being exhausted, the object is attained. But in cases where the rock is nearly in a vertical position, and contains partial collections of water in fissures and cavities, it is necessary to carry a drain to each outlet.

When hills are composed of alternate strata of rock, sand, and clay, the surface of the clay is sometimes soft and spongy, while the soil incumbent on the rock and sand is sufficiently dry to produce good herbage. Here a drain is required for every division of wet and dry soil. Figures 1. and 2. Plate 2. will serve to illustrate the method of draining in such a case. Fig. 1. a plan of the ground, in which AAA represents the dry porous soil; BB, BB, BB, the wet soil. A drain C is cut under the upper line of springs *aa*; a second drain C along the next lower line *aa*; and a third C is cut along the lowest *aa*; and a communication being formed between each of these drains, the whole collected waters are conducted to the nearest outlet. Fig. 2. is a section of the same hill; AAA the dry and porous strata; BBB the clay or impervious strata, on the surface of which the wetness appears; C the upper line of springs, with the drain or cut immediately below it; D the second line, with their drain; E the third line, with their drain; and F the lowest drain, by which the whole water is discharged. We have not mentioned the boring operation in this case; but it may be equally efficient when particular circumstances require it.

Drainage of land-locked bogs.—A most important and beautiful application of the same principles has been made in the draining of bogs, or morasses, which are surrounded on all sides by high impervious banks. Fig 3. Plate 2. represents a bog, or morass, of this description. ABCD is the high bank of clay, or other impervious substance; EFG the wet or boggy ground; HIKL the points where the transverse drains meet the longitudinal drain. Fig. 4. is a section of the same bog, and of the contiguous strata. AB the high impervious bank, connected at NOP, and containing the water as in a bason; CD a porous stratum below, under which EF is a stratum of impervious clay; GHIK are the drains, at the bottom of which the auger is inserted. Draining.

In carrying off a collection of water in such circumstances, the first step is to form a drain in the middle or lowest part of the boggy ground; and to this drain all the others, the number and direction of which regulated by the extent of surface to be drained, are conducted. When the drains have been carried to the impervious stratum of clay, the use of the auger is had recourse to, to perforate the stratum, and to allow the water to escape to the porous stratum below, from the lower part of which it may be discharged by some convenient outlet. It is not necessary that the drains in such cases as the present should be wide; they may be cut as narrow as can be conveniently executed; they should be filled up with small stones to within a foot and a half of the top, that the water may be permitted to ooze freely through the peaty soil and escape downwards; and they should be covered, that no earthy matters may be washed into the auger holes and choke them up. A bog of this description has been successfully drained in this way in Dumfries-shire, on Mount Annan, belonging to General Dirom. In the counties of Peebles and Roxburgh, in Scotland, similar attempts have been made with equal success.

Sect. III. *Of the Construction of Drains.*

In planning and executing drains, various objects must come under consideration; as, the dimensions,—the implements to be employed,—the materials for filling them,—the expence,—and the season in which the work should be done. On the first point little need be said. The dimensions should be such as to allow the water to pass off freely, and the sides should have a greater or less degree of slope, according to the nature of the soil and strata through which the drain is carried.

Implements.—In many cases the usual implements, as the spade, shovel, and mattock, are all that are required. But in cutting narrow drains to a considerable depth, a spade whose lower extremity is considerably narrower, and another which terminates in a point, are very useful instruments. A scoop, which forms nearly a right angle with the handle to which it is attached, is a necessary implement for clearing out earth or gravel from the bottom of drains. The auger, or wimble, employed in draining, resembles the wimble of the carpenters; the diameter is 3 inches, the length of the hollow part is 18 inches, and the opening at the sides is only 1 inch. The rods to which the auger is screwed are $1\frac{1}{4}$ inches square, and 4 feet long, and they are also screwed to each other. The construction and management of the boring apparatus are exactly similar to that employed in searching for coal. A chissel $2\frac{1}{2}$ inches broad at the point, and well sharpened, is necessary for cutting through stone; a punch $1\frac{1}{2}$ inch square, also with a sharp point, is requisite for perforating gravel; and a kind of scoop should be made for cleaning the auger.

The operation of boring is conducted exactly in the same way as in boring for coal; and the only precaution to be recommended is, that the perforation should never be carried deeper than the length of the auger without withdrawing and cleaning it; for the earth and gravel are apt to fill up the vacant space above and render it extremely difficult to pull it up.

Materials for constructing hollow drains.—The selection of the materials for constructing or filling drains is not always left to choice; and as the quantity required is often very considerable, such as are most abundant are preferred to what are of a more durable nature, from motives of economy. Very different materials have been employed for this purpose, as bricks, stones, wood, brush-wood, straw, &c. But the various methods which have been adopted may be readily understood by a short reference to the figures.

Fig. 5. represents a drain of $2\frac{1}{2}$ feet wide at top, and 18 inches at the bottom, cut through one foot of porous upper soil at A, one foot of sand and gravel at C, and six inches of clay at D. The passage for the water at D, of six inches square, is formed by a line of stone, and is covered with a flat stone, four inches thick. A layer of rounded land stones, one foot thick, replaces the sand and gravel at C. An inverted sod, two inches thick, covers the stones, and the space above is filled with loose mould.

Fig. 6. is a drain nearly of the same dimensions, and cut through similar strata. The opening for the passage of the water is triangular, and six or eight inches wide; it is covered with a flat stone, four inches thick at D. The space at C is filled with rounded land stones, or faggots of brushwood; the covering at B is an inverted sod, straw, heath, or rushes, and the loose mould at A fills it to the top.

Fig. 7. is also of the same dimensions, and is filled with the same materials; the opening of six or eight inches being triangular, or coupled, is formed by two flat stones, placed on the stratum of clay, and brought into contact at the top.

Fig. 8. is a drain of $2\frac{1}{2}$ feet wide at top, and one foot at bottom, cut entirely through clay soil. It is filled up with a stratum of land stones of 20 inches in thickness at C, which is covered with four inches of sod, straw, heath, or rushes; and the remaining foot to the surface is filled up with loose mould or gravel.

Fig. 9. is a drain of the same dimensions as the last, in which brushwood is placed lengthways, and supported by cross billets of wood, leaving a triangular passage at the bottom, and the sides open to the height of the cross billets, which is 18 inches at C. The brushwood is covered with a layer of strong heath or rushes at B, and the loose mould is thrown in to the top.

Fig. 10. is a drain cut into clay soil, having a triangular opening C, of one foot deep, and eight inches wide at the shoulders, formed by the pointed draining spade. It is covered with six inches of inverted sod B, and the upper part is filled with gravel or loose mould.

Fig. 11. is a drain formed in 1 foot of gravel or porous soil, and a triangular opening C is formed a foot deep in clay. The opening is filled with three large straw ropes, placed length ways. A layer of six inches of clay is trodden down, and the drain is filled with gravel to the surface.

A simple and ingenious method of constructing a pipe drain has been practised, by digging it to the depth required, and making it very narrow at bottom. A smooth cylindrical piece of wood is prepared, of ten or twelve feet in length, of six inches diameter at one extremity, and five inches at the other. A little sand is scattered in the bottom of the trench; the tree is then laid in; and, after a little more sand has been thrown on its upper side, the clay, or most adhesive part of the materials, is first replaced; the trench is then filled; and the whole is firmly trodden down. By means of a ring or rope attached to the tree, it is drawn out, leaving only a foot or two of the smaller extremity covered, and the repetition of the operation is continued till the work be completed. This clay pipe, which in one case has remained in good repair for above twenty years, is supposed to answer better for the conveyance of water than for drying the soil.

The best season for executing work of this description is summer or autumn, when the surface of the soil is most free from moisture. The expense of draining, it is obvious, must vary according to the price of labour in different districts, and the abundance or scarcity of the requisite materials. But it has been stated, that the expense of draining in few situations has exceeded L.10 per acre; in many it is much less; and this must always render it an object of economical management.

Sect. IV. *Of Embankments.*

A great deal of valuable land has been protected or reclaimed from inundations of rivers, the sea, or lakes, by judicious embankments. In this way extensive tracts of the very best kind of land have been gained, and in many cases at a very trifling expense. The ingenuity and industry of the Dutch, in executing works of this kind, are well known. A large proportion of the flat country of Holland has been gained in this manner; and in England, Scotland, and Ireland, a great extent of the richest soil has been brought to a cultivated and productive state. Embankments for protecting or reclaiming land are employed against rivers, lakes, and the sea.

Embanking of rivers.—The embankments against rivers are intended to prevent their encroachment on the lands contiguous to their banks, or for protecting the adjoining flat country from being overflowed in the time of floods. A river running nearly in a straight line, rarely encroaches upon its banks, unless when it is large, and rises above its ordinary level, by an increase of its water, or by an influx of the tides of the ocean. When any injury is threatened to the bank from these causes, it may be secured with stones, or by driving a row of long piles pretty close together, at a small distance from the shore. The piles must be of such a length, that their tops shall be always above the highest rise of the water. Very remarkable effects have been produced by such a construction in resisting the force of the waves; and an example of a successful operation of this kind, executed by Mr Beatson, to defend the walls of a fort near Portsmouth from the waves of the sea, has been often particularly mentioned. The same simple method is recommended to protect the

Draining.

banks of large rivers which are exposed to the violence of the waves.

But the most common injury to which the banks of rivers are subjected, arises from abrupt turns in their course, in consequence of which the whole force of the stream is directed against a small space. In rivers which flow through flat countries, and are of no great magnitude, the most effectual method of proceeding to prevent the injury would be to straighten their course. But when the size of the stream, and the particular situation, render this plan impracticable, the force of the water is either to be diverted to another point where it can produce no injury, or is to be divided, or as it were spread over a larger surface. The force of the current may be directed to another point, by forming some obstruction at a short distance above the place where the obstruction has commenced. This is usually done by means of a wall of stone carried out from the bank towards the middle of the current, and pointing down the stream in such a way that it shall form with it a pretty obtuse angle. But it would be a more effectual method, where it is practicable, to enlarge the turn or bend of the river; by which the force of the water, acting on a wider surface, is greatly diminished at particular points.

Rivers are embanked to prevent them overflowing and inundating large tracts of flat country. Inundations of this kind may sometimes be obviated, by giving the current as much space as possible, by widening the bed of the river at narrow places, and by removing every kind of obstruction, as shoals, stones, trees, or bushes. But where embanking is unavoidable, the banks should be erected at such a distance from each other as shall allow sufficient space to contain the whole water in the time of the greatest floods. It rarely happens that rivers which flow with a free and uninterrupted current, even during the greatest floods, rise higher than five or six feet above their ordinary level. An embankment, therefore, of six or seven feet in height, will, in general, be a complete security against inundation. The base of an embankment should be three times the breadth of its height, and the width at top should be at least one third of the height, and the slope should always be greatest towards the stream, by which the force of the water is diminished. If an embankment be six feet high, the base should be eighteen feet, and the top is diminished to two feet. The line of an embankment should be at a proper distance from the edge of the river; and the whole materials of which it is formed should be taken from the land side, that the surface next the river may not be loosened and exposed to its encroachments. All trees and bushes should be removed from the space between the embankment and the river, that no interruption may be opposed to its current; and none should be allowed to remain in the line of the embankment.

In the construction of an embankment, the materials of which it is composed should be made as solid and compact as possible, by being trodden or beaten down with heavy mallets; and when there are any substances of a tough nature, as clay, they should be employed on that side next the river. When the slope is finished, the same side is carefully covered with well swarded turf, the first layers of which, next the foundation, it may be necessary to pin down; and in dry seasons it may be proper to water them, to make them adhere more firmly together. The land side of the embankment is sown with grass seeds; and it may be useful in thickening the sward to do the same on the other side. Embankments of rivers should commence at the upper part, and be carried downwards; and each day's work should, if possible, be entirely completed, to prevent the injury from sudden swells of the river; and, that the embankment may be uniform and regular through its whole course, a wooden frame, of the exact form and dimensions, is constructed for the direction of the workmen. A back drain, at the distance of two or three feet from the inner edge of the bank, is necessary to receive the surface water; and the whole water collected in the adjoining fields should be discharged by one outlet only, at the lowest part of the embankment, by means of a pipe or square wooden box, having a valve or lid attached to the mouth, by hinges on the upper side. This valve, shutting in the time of floods, excludes the water of the river; and opening by the pressure of the water from the land, allows it to escape when the river subsides. No trees or shrubs that penetrate deep with their roots, or grow to any considerable height, should be planted on the sides or top of an embankment; for they loosen the earth, and shake the whole mass: but rushes, flags, colt's-foot, and some other plants, may be sown and encouraged to grow, because their roots, stretching along the surface, and forming a kind of close mat, increase the solidity of the construction. Embankments, even when they are finished in the best and most careful manner, should be frequently examined, that the slightest breach which appears should be instantly repaired; and mice or mole holes, which give free admission to the water, and may be the commencement of the most serious injury, should be immediately shut up.

Embankment of lakes.—The waters of many lakes cover a much greater extent of surface in winter than in summer. It would therefore be an important object, and some valuable land might thus be acquired, to confine them within the narrowest limits. In some cases, this may be effected by widening and deepening the principal outlet; but if the level of the ground should not admit of this method being pursued, or if an intervening mass of rock should render the operation too expensive, the water may be confined by an embankment. The summer season, when the water is lowest, is undoubtedly the best time for attempting an operation of this kind; and the dimensions of the embankment, and the necessary precautions in proceeding in the work, completing and securing it, are similar to those already stated. A back-drain, to carry off the surface-water, is also required in this case; and when the lake is surrounded by elevated ground, it may be proper to conduct another drain along the line of springs which burst out from the adjoining bank.

Embankment of the sea.—The sea increases on the land, either by destroying and washing away the materials, when they are of a loose and soft nature, or by overflowing flat grounds during high tides. When perpendicular cliffs of clay, or other alluvial soil, mixed with loose stones, are opposed to the force of a stormy ocean, its ravages are almost irresistible. The usual mode of defending the land, in such cases, is by constructing a bulwark of stone in front of the bank. To give complete security to such bulwarks, the base should be broader, and the slope greater, than they are usually made, while the top of the building should be so elevated as to be above the reach of every tide. Piles driven into the shore, in front of the bulwark, have been found a very effectual expedient in breaking the force of the waves; but one of the most important precautions, in bulwarks of this kind, is, to secure the whole line of coast which is exposed to the action of the waves; for if the water be admitted at any one point behind the embankment, it produces a double injury, not only by its pressure on the stones while it recedes, but by washing out the earth from behind them, and loosening their foundation.

When it is difficult, or very expensive, to procure proper materials for such works, and when the force of the water is not very great, an embankment may be constructed of small stones, coarse gravel, or broken bricks. By spreading them about a foot thick on the surface, and beating them well down, a safe and durable fence is formed. But embankments of this description must have a greater degree of slope.

Some of the richest, and most fertile land in the kingdom, has been reclaimed from the sea by means of embankments. Such land is generally situated at the mouths of rivers, or on the shores of bays, or arms of the sea. The facility of reclaiming land which is covered every tide, in bays, creeks, or on the side of a large river, must depend on the depth of the water, the rapidity of the current, and the prevailing winds, and its expence and success on the nature of the soil, or materials of which the beach is composed. If the materials be of a sandy consistence, the embankment must be faced with stones on the side next the sea; but where the materials of the bank are of clay, or some adhesive matter, strong turf may be employed; but it must be well beaten, and secured with pegs. The height and solidity of embankments of this kind are determined by the rise and force of the water. In the inside of sea embankments, drains are to be cut to carry off the surface water, and sluices are to be constructed, to allow it to escape during the ebb-tide. In some cases the course of a stream has been advantageously changed, to allow it to discharge its waters where it is less liable to injure the soil; and in one case the course of a river was reversed, by conducting it in an opposite direction.

Chap. II. Of Inclosing Land.

The whole of a farm is rarely or never under the same species of crop at the same time. One part is under arable culture, and is appropriated to the production of corn, and another is in the state of pasture land: and while the latter is consumed by live-stock, the former must be protected from their ravages. Hence inclosures and fences become an object of great importance in all well managed lands, and contribute essentially to the successful prosecution of every regulated system of husbandry. In the present chapter, which is devoted to that subject, we shall treat first of inclosures, and secondly of fences.

Sect. I. *Of Inclosures.*

Number of inclosures.—The situation and extent of a farm, the nature of the soil, and the kind of husbandry to be adopted, must in a great measure direct the number and extent of the divisions or inclosures into which it ought to be formed. If the same species of crops, and a similar system of rotation, are pursued on two farms, one of which is double the extent of the other, the number of divisions for the conveniency of management must be the same; but the size of each division on the farm of smaller extent can only be one half.

In the general division of arable and pasture lands on any possession, it is always found convenient to have a few inclosures in the state of grass, near the house or farm offices. Such inclosures may be considered as exclusive of the more general distribution of the farm into arable and pasture lands; for while such portions of it as are usually cut for hay, or are employed as pasture for store cattle and sheep, may be, without inconvenience, laid out at a distance, those which are usually under arable crops should be near at hand, that time and labour may not be lost in the travelling of the teams and the cartage of the various kinds of produce.

The quality of the lands must have considerable influence in regulating the size and number of inclosures. In farms which have a sufficient extent of land of opposite qualities, as those that are porous and absorbent, and such as are retentive of moisture, it may be a convenient and judicious plan to have two sets of inclosures, by which means the whole operations connected with arable culture may suffer less interruption from the extremes of wet and dry weather, and the live stock may have an ample provision of pasturage during all seasons. If, for instance, in the system of rotation, a six years course be adopted, the division of the farm into twelve inclosures will be found extremely commodious. By this arrangement, two inclosures of different kinds of soil, of different degrees of fertility, and in different parts of the possession, may be under the same crop, and thus equal distribution of labour, and equal returns of produce, which are no inconsiderable advantages, are attained. In cases where the turnip husbandry forms part of the rotation, two inclosures in different situations, the one in a distant part of the farm, and the other near the offices, afford the means of obviating the great expense and trouble of conveying the produce from any unnecessary distance. The fields of turnips near the house may be reserved for consumption in the straw yard, while the more distant crop may be conveniently eaten on the ground. The diversity of soil which often prevails in the same field, when it is of large extent, frequently occasions considerable variation in the quantity of labour required in working it, as well as in the amount of produce which it yields. One part of a field of this description may have a poor soil, and require great labour

Inclosing.

and exertion in its preparation, while another part is of a richer quality, and is wrought with greater facility. One part of a large field may be of such a nature, or so favourably situated, as to admit of all kinds of operations during a great part of the season, while another part can only be attempted in the most favourable periods. But when such fields are divided into one or more inclosures, one which is of a poor soil may be combined with another of a richer soil; one which is easily cultivated may be joined with another which requires much labour; and thus the quantity of labour, and the amount of produce, may approach nearly to the same point during all ordinary seasons.

In the distribution of pasture land, it has been recommended to have two or more inclosures, in preference to the same extent in a large field. By this subdivision, the stock may be separated into small parcels, and that portion of it which is first intended for the market may be introduced to the earliest and best pasture. In the most celebrated grazing counties of England, inclosures of a moderate size are found to be highly advantageous: but at the same time it is recommended that sheep pastures should be of large extent; for as this species of stock is more restless, and more easily disturbed than any other, and as they are apt to be impatient of heat, and often greatly annoyed by insects, when they are confined in small sized inclosures, surrounded by high hedges and trees, they ought to have a wider range in larger fields.

Form, &c.—The shape or form of inclosures is, in some measure, regulated by the form of the farm, the nature, surface, and aspect of the grounds, and the direction of the roads and water-courses by which it is traversed; but, in general, when it can be managed, inclosures in the form of a square, or long square, should be preferred, and all crooked and irregular shapes should be avoided. The two sides of the inclosure should lie parallel to each other, for the conveniency of arranging the ridges; but it is equally, if not more necessary, that attention should be paid to the uniformity of soil in the same field.

The direction of inclosures, when it is compatible with the form of the farm and other circumstances, should be the same as that in which the operation of ploughing can be most conveniently accomplished. The direction of an inclosure, on a level surface, or one with a gentle inclination, where the retentive soil requires to be laid up in rounded ridges, should be nearly north and south; because, by such an exposure, the crop on the different sides enjoys more equally the influence of the sun, and comes more regularly to maturity. But in situations where the surface is steep, and the soil also retentive, the direction of the inclosure is regulated by the nature or face of the slope, winding to the right, when standing on the brink of it, for the purpose of arranging the ridges in the same direction, and of more easy ploughing them. But when the soil is of an absorbent or porous nature, and the slope very steep, the direction of the inclosure should be turned downwards of the declivity.

In laying out watered meadows, where the situation admits of such, attention must be paid to the nature of the ground, that a full command of water may be at all times within reach. And, in inclosures destined for pasture or grazing lands, it is scarcely necessary to add, that an abundant supply of water is of essential benefit to the stock; so that, in the subdivision of the grounds, the means of obtaining it should be always kept in view. In the subdivision of land, some advantage may be obtained, by combining the means to be adopted in draining, with the arrangement of the inclosures; and this advantage ought not to be overlooked.

Advantages.—Inclosures are not only useful, in ascertaining and securing property, but they afford the utmost facility to improvement in all systems of management. In consequence of the shelter which is thus obtained, the quantity and value of the produce are increased. When under arable culture, and when in the state of pasture, the greater number and superior value of the live stock reared on an equal extent of ground, are universally admitted. Inclosing is stated as the first step towards effecting improvements in the breeds of the different species of live stock; but the additional rent, which is obtained for inclosed land of equal extent and quality with that which is in the state of open field, affords the most satisfactory proof of its advantages.

Sect. II. *Of Fences.*

Fences are not only useful in affording shelter to inclosures, but are necessary for confining live stock, and protecting arable crops from their depredations. Fences have been divided into two kinds, *simple* and *compound*. Ditches, hedges, palings, walls, &c. belong to the first kind; and under the second, are included such as require the assistance of another kind of fence, either to protect or render them secure, as hedge and ditches, or banks, hedge and wall, &c.

Ditch-fence.—In some cases, ditches are not only employed for the purpose of carrying off water, but also for that of a fence to the inclosure. With this view, it is necessary that they should be deep and wide; and the earth thrown out being formed into a bank on one side, adds considerably to the depth of the ditch, and forms a tolerable fence. Ditches are made of various forms; but the sloping form is to be preferred, as it is not only constructed originally at less expence, but is more durable. But ditches of this description are more generally employed in conjunction with another kind of fence. The simple ditch, with a bank of earth, is a fence consisting of a sloping ditch, and of the earth taken from it formed into a bank on one side. A scarcement, or vacant space of six or eight inches broad, is left between the bank and the edge of the ditch, to prevent the loose earth from falling in and filling it up. The double ditch, with a bank between, is but rarely employed, excepting where hedges or trees are to be planted on the intervening bank. It affords a better fence than the single ditch, and it is highly useful as an open drain of lands on the sides of highways, where there is a considerable declivity towards the road. The field-ditch receives the waters from that side, and the road-ditch prevents it from being overflowed and injured. In dividing high from low, Inclosing.

flat lands, and especially where the high grounds have a sudden slope, the double ditch is extremely useful. The ditch on the side of the high ground preserves the lower fields from inundation in the time of heavy rains, and the ditch on the other side is a drain for the flat land. When ditches of this description are constructed near high grounds, or on the sides of high ways, the precaution of altering the direction of the furrows, or side ditches, by giving them a gentle curve a few yards from their junction with the main ditch, cannot be too strictly observed; otherwise the water falling into the ditch with the force of an unbroken current, is apt to undermine the bank, and wash away the loosened earth.

A fence composed of a sloping bank of earth, with a perpendicular facing of sod, is very useful in making folds for sheep or cattle, for defending gronnds adjoining to high ways, for laying off clumps or belts of planting in the middle or corners of arable fields, or for inclosing cottages, gardens, or stack-yards. In constructing this fence, the sod pared from the surface of the sloping ditch forms the front of the bank, and the earth thrown out forms the bank itself. When this kind of fence is employed for the purpose of a fold, the perpendicular front, as it presents a more formidable appearance, should be placed on the inside of the inclosure, but in general the bank is in the inside, and the front on the outside of the field. Fences of this description are to be regarded only as of a temporary nature, but may be employed as a useful substitute for paling where wood is dear, or for other materials for the shelter of young hedges.

The Ha-ha, or sunk fence, resembles the preceding in its mode of construction; but in this case the front or facing is composed of brick, dry stone, or stone and lime. The height varies according to the nature of the grounds, and other circumstances. Fences of this kind are chiefly suited for gardens and extensive lawns, for the purpose of preserving the prospect uniform and uninterrupted; but without a hedge planted on the top, the sunk fence scarcely affords any shelter.

The double ditch, with a hedge in front of each bank, is employed in different parts of Britain, and particularly what are denominated cold lands, from a prevailing opinion that a single hedge would not form a sufficient fence; and, besides, it is supposed the advantage of additional shelter is derived from a row of trees planted on the middle of the bank. But the expence of a fence of this kind, and the quantity of ground required being double, are serious objections to its use; and, besides, the bank in the middle is cut off by the ditches from the adjoining grounds, and the nourishment of the double hedge and the row of trees is limited to the insulated mound, so that they are liable to be affected by drought or frost.

Hedge fences are either formed of living plants or of dead materials. Dead hedges are constructed with the prunings of trees, of the tops of old thorn or beech hedges that have been cut over, and are chiefly employed and well adapted for the temporary purpose of protecting young hedges. In some cases dead hedges are the only fence; but being of a perishable nature, the necessary repair, after the first or second year, is attended with great expence. When the protection of a young live fence, planted upon the common surface, is the object of the dead hedge, it is made in a trench or furrow immediately behind, that the sheep or cattle grazing in the inclosure may be prevented from injuring it. When the quick fence is planted upon the side of a ditch, the dead hedge is generally made on the top of the bank.

Inclosing.

Dead hedges are variously constructed. In some, the thorns, or brushwood, of which they are composed, are cut into certain lengths, and fixed into the earth. These are called plain dead hedges. In other dead hedges, the upright stakes are let into the earth about twelve or fourteen inches, and fastened at the top with willows or hazels. The wattled dead hedge has strong upright posts, and is well known in Scotland by the name of *stake* and *rice*. But it has been justly observed, that fences of this nature are a very unprofitable substitute for a live hedge, for they are attended with the constant expence of repairs; and there are scarcely any situations where some species of living plants would not only grow and thrive, but the original expence would perhaps even be less than for these temporary constructions; and it may be added, that the live hedge growing annually stronger, would afford shelter to the inclosure, and become an ornament to the country.

Live hedges.—Various trees and shrubs have been employed, for the purpose of constructing live hedges; but it is a matter of great importance to select such plants as seem best suited to the soil and climate; and in this choice some aid may be obtained by observing the native trees or shrubs which thrive most vigorously, and attain the largest size, in particular climates, and on certain soils. But in situations where such plants do not appear, recourse must be had to experience, to ascertain what kind of plant is best suited to the soil and situation. The hawthorn, for instance, which has been often very injudiciously employed in such cases, is extremely ill adapted to lofty situations; but beech, birch, larch, and the Huntingdon willow, can be reared in a short time, and form good fences in hilly countries, or upon cold wet soils. The first three should be preferred when the soil is dry; and the willow, with the addition of poplars, may be successfully planted in wet and marshy places. In the low countries, or in less elevated upland situations, birch, poplar, alder, and Huntingdon willow, are best suited for cold, wet, and marshy grounds. Beech, crab, and some other plants, answer well on stiff clays; but on loamy, sandy, or gravelly lands, where the soil is dry, the white thorn, hazel, sweet-briar, and rowan tree, are most advantageously employed in the construction of hedges.

It rarely happens, whatever may be the quality of the soil, that it is equally suitable for the vigorous growth of every kind of plant; and, besides, the growth of different species of plants is seldom the same on the same soil, so that the certain consequence of different plants in the same hedge, is, to produce inequalities and defects. But although the soil were equally favourable to the growth of the different species employed, when planted separately, those of a climbing nature, as the ivy and honeysuckle, by twisting round the thorns or other plants

Inclosing. near them, in a short time entirely interrupt their growth. The different kinds of sweetbriar and brambles, have a similar effect; for in the end, by overshadowing and smothering the thorns, they never fail to produce an unseemly gap.

Preparation of the soil.—In planting hedges, by far too little attention has been paid to the preparation of the ground; from which it has often happened, that a stunted and useless hedge appears in a situation where a vigorous and excellent fence might have been reared. When it is intended to plant a hedge, the ground should, in every instance, be previously prepared by a complete summer fallow, for the destruction of weeds. A certain proportion of lime, dung, or compost, is next to be laid on the tract upon which the hedge is to be planted. The manure being properly mixed with the soil, a furrow is drawn with a common plough about the end of November, and in this furrow the plants are arranged, and the earth drawn close to their roots.

Time, &c. of planting.—Whatever be the nature of the plants of which the hedge is intended to be made, they should be put into the ground before the approach of winter, or early in the spring, before vegetation commences. The beginning of November, or any time during the month of January, is found to be the most proper season for planting thorns; and if they have been carefully removed from the nursery ground, with their roots uninjured, they are scarcely checked in their growth; and they shoot out more vigorously in the first year than in three or four years by less careful treatment.

When a hedge is made in the face of a ditch, bank, or wall, the plants are generally laid horizontally upon the surface, or upon a paring of sod taken from it. They are then covered to the length of from seven to nine inches from the root end, while three inches only are left to project. In this way the roots have sufficient room to stretch out, and the projecting part produces only two or three good shoots, which become healthy and vigorous. The future strength and value of the hedge depend on the number and vigour of the first shoots; so that no care should be omitted in preparing and manuring the soil.

In planting a hedge upon the common surface, a furrow of eight or nine inches deep is made with a common plough, upon the tract previously prepared; and that the furrow may be clean, the plough is twice drawn along it. A labourer then, with a bundle of plants, goes along the furrow, and drops them in handfuls of six or eight, at certain distances. Having finished 100 yards in this manner, he returns to the spot where he commenced, takes up the first handful, and places each plant in the bottom of the furrow, leaning against its perpendicular side, and at the distance of from four to six inches from each other. The whole plants being thus arranged, they are covered with the earth which has been turned up by the plough. He then sets a foot on each side of the hedge, and moving slowly along, treads the earth close to the roots of the plants, after which the operation is finished, by pointing the soil with a spade on each side. When the ground is properly prepared, a single labourer is capable of planting several hundred yards of thorns, or other hedge plants, in a day. In some cases the dibble is employed in planting hedges; but by this practice the fibres of the roots are greatly injured, by being pressed together, or, if they are pruned, their growth receives a severe check.

Inclosing. *Age and size of plants.*—It is a common practice to plant thorns of three years old, and it seldom happens that they are allowed to exceed this age; and, with proper preparation of the soil, regular weeding and digging, a good fence is obtained; but it cannot be doubted, that plants of six or seven years old would afford an earlier and better fence. When plants of this age are employed, the precaution of preserving the roots entire should be particularly observed. It is no small advantage to arrange thorns or other hedge plants according to their size and apparent strength, because plants of the same size and strength keep pace with each other, and the growth of the whole is regular and uniform; but when strong and weak plants are brought together, the stronger soon outgrow and overtop the weaker, so that inequalities and gaps soon make their appearance. By assorting hedge plants in this manner, the strongest and healthiest may be planted upon the poorest part of the soil, in the line of the fence, and the smallest and weakest upon the richer and more fertile parts. By this management, a strong and equal hedge may be reared through the whole line.

Pruning before planting.—The practice, which is by no means uncommon, of pruning the tops, and cutting off the greater part of the roots of thorns, is extremely injurious to their future progress and growth; and it is also not unusual to take them up in great quantities, tie them up in bundles, and allow them to remain in this state for many weeks. It is not generally known, that plants derive their nourishment from the earth, by means of the extremities of the small fibres, and when these are cut off, the growth of the plant is completely interrupted, till a new set of fibres shoot out. To avoid this and other injuries, thorns should not be raised from the nursery ground till the day on which they are to be planted out; and, instead of the spade, they should be taken up with a dung fork, having strong round prongs; and while the roots are carefully separated from the soil, the smallest fibres should be preserved. The top of the plant only, if that be necessary, should be pruned.

Weeding hedges.—Whatever attention may have been paid to the preparation and planting of a hedge, its vigorous growth depends greatly on its future treatment; and one of the first requisites in the management of a hedge is weeding. Annual weeds are removed by a slight scuffle with a hoe, and the operation is to be repeated as often as a new crop appears. Perennial or biennial plants, which have strong roots, are most conveniently eradicated by means of the dung-fork already recommended for raising thorns from the nursery. This implement is preferable to the spade, because, without cutting the roots of the hedge, it loosens the ground, to allow the weeds to be removed. The first weeding of a young hedge should be performed early in the spring. Loosening the earth at this time is also advantage-

Inclosing. ous, when the roots begin to spread and extend themselves. Annual cleanings and loosening of the soil about the roots are essentially necessary, to promote the growth and vigour of every hedge. But, besides this advantage, it is not less necessary to keep hedge banks free from weeds on account of the adjoining fields, which are soon overrun by plants springing up from seeds produced in the hedges or highways. It would, therefore, be a public benefit to have the whole weeds round the line of fences, as well as in the high-roads and uncultivated spots of ground, cut down before the time of flowering and running to seed.

Pruning hedges.—Much of the future value and beauty of a hedge depends on the proper pruning and after-management. But concerning the mode of pruning, and the season of the year when it should be performed, great diversity of opinion prevails. To have the best and most useful hedge, it should be pruned in such a way as to be broad at the bottom, and should taper gradually towards the top. The summer season, the most improper that can be chosen, is often selected for the operation of pruning, when the plants are full of juice and vegetation is in its most vigorous state, in preference to the commencement of spring or the end of autumn, when they are less liable to injury from bleeding. After the first pruning, already noticed, when the hedge is planted, it should scarcely be touched with the knife or shears for some years. When the main stem of a thorn, or indeed any other plant, is cut over, it sends out lateral shoots, or a number of small stems, at the place where it is cut; and if this injudicious operation be repeated once or twice every year, each small stem is again subdivided, and the upward progress of the hedge is completely interrupted. A hedge thus treated cannot be recovered but by cutting over close to the ground, when healthy and upright stems shoot up vigorously, and soon form a sufficient fence.

The first general rule that can be given for the management of a young hedge, is to leave the main stem untouched till it has reached the heighth of five or six feet. Whatever pruning it has received should be entirely confined to the side branches, those next the root being left pretty long and tapering gradually towards the top. The side branches thus pruned send out new shoots from their extremities, which become so thick as to fill up all the interstices, while the main stems are left untouched, and shoot upwards to the necessary height. Regular switching with a hedge bill, is all that is afterwards required in the proper management of such a hedge.

Cutting down old hedges.—When hedges are neglected, they shoot up to a great height, become open below, and often useless as a fence. The only method of recovering hedges treated in this way, is by cutting them down to obtain a new set of shoots from the stumps. In fields surrounded by such hedges, if they are alternately in pasture and tillage, the proper period for cutting them down is when the field is under corn crop. Different methods are recommended for performing this operation. In the first, the hedge is cut over a yard above the surface, and is left in that state; this mode of treating a hedge originally good, fully answers the purpose, and in a few years, with proper management, it becomes an excellent fence; but if there has been a deficiency of plants, numerous gaps appear, which it is extremely difficult to fill up. But it is a more serious objection to a hedge being treated in this way, that live stock attempting to leap over it, run the risk of being destroyed by the sharp points of the stakes. Inclosing.

A second mode of managing an old hedge, is, to cut over a fourth-part of the hedge to the intended height of the fence, and to bend down and warp the remaining three-fourths with the upright stems. In this way the gaps and vacant places below are effectually filled up, and, with proper attention, a good fence is soon obtained.

A third way of treating old hedges is, by cutting them close to the surface; when there are no gaps, this method answers sufficiently well, but otherwise the defect soon appears. This method is inferior to the one last mentioned, but is preferable to the first; for the young shoots from the stumps, by being near the ground, in some measure supply the deficiencies occasioned by the want of original plants.

The last method of managing old hedges is to cut them down even with the surface, and to cover the stumps completely with earth from the ditch or the road side. By this treatment every single root sends out a great number of young vigorous shoots, each of which branches out from the stump below the surface, sends out roots, and acquires an establishment for itself. In this way the bottom of the hedge becomes so thick, that no kind of animal can force its way through it. In the future management of such renovated hedges, the same directions as for young hedges must be attended to, and particularly the precaution of saving the upright shoots till the hedge has attained the proper height, should be strictly observed. The proper season for cutting over old hedges, as well as for pruning and switching them, is either at a late period in the autumn, or very early in the spring.

Filling up gaps in hedges.—To prevent the occurrence of gaps in a hedge, it should be carefully examined about the end of the first autumn after it is planted, and dead and decaying plants should be removed, and replaced by the strongest and most vigorous that can be found. With such attention for the first two or three years, the hedge becomes uniformly thick and strong, and few defects appear. But when old hedges are to be cut down, some means must be adopted to fill up the open spaces. The common method is, to select a strong plant next to the gap, and, with a gentle stroke of the hedge-bill to bend it across the opening, and entwine it with the thorns on the opposite side. When the old hedge is cut down close to the earth, gaps are effectually filled up by digging the ground pretty deep with a spade, and taking one of the strongest plants on each side of the opening, that have been left uncut, removing the earth from the roots, so as to loosen them, that they may be bent down and laid close to the earth in the gap. They are then fastened down with wooden hooks, and covered throughout their whole length with earth. Young shoots soon appear from the old stems to fill up the vacancy. This method answers well with a hedge that is cut over close to the surface, but when

Fences.

it is cut at the height of three or four feet, a temporary paling, to protect the young shoots till they become a sufficient fence, must be erected.

The gaps of a hedge which has been cut over at the height just mentioned, may be effectually repaired by planting old thorns, when such can be obtained, the earth in the gap being previously stirred up and manured. The end of autumn, or the beginning of winter, is the proper season for this operation.

Strong beeches have been successfully employed to remedy the defects of grown up hedges. The plants should be six or seven feet in height, and supported by a couple of pieces of coarse paling, placed across the opening. Beeches of this description, planted early in the winter, suffer no check, and shooting out vigorously in the spring, fill up the opening during the first season.

It is a common practice to fill up gaps in hedges with dead wood, such as the prunings, and other brushwood; and for the same purpose stones are sometimes employed: but the use of such matters is at best only temporary, while they serve to continue and enlarge the opening.

Plashing hedges.—In performing this operation, the old hedge is first cleared of all dead wood, brambles, and other straggling plants, leaving along the bank the straightest and best growing stems of thorn, hazel, elm, oak, ash, beech, &c. about five or six in a yard; but where there are gaps, a greater number is left. The ditch is then repaired, and the earth thrown on the bank. Such of the stems left in cutting the old hedge as are found growing in the line of the new hedge, are cut off three feet from the top of the bank, and are employed as hedge stakes to the new hedge. This is an essential part of the practice; for these stakes being immoveable, and never rotting, prevent the new hedge from falling, or inclining to any side. Dead hedge stakes, such as sallows, or willows, which may grow, are driven into vacant spaces. The wood left standing in the remainder of the line is then plashed down; the stem is cut in two places; it receives one stroke near the ground, and the other about ten or twelve inches higher. The cuts should be of sufficient depth to admit part of the wood between the two being slit out, the stem itself being supported by little more than the bark, or about a quarter of its first size. It is then laid along the top of the bank, and interwoven with the hedge stakes. In plashing hedges, the cuts should be directed upwards, instead of downwards, by which the heart of the plant is exposed to the weather. In all cases where old hedges are either cut over or bent down, the ground on each side, as soon as it can be accomplished, should be well dug, cleared of weeds, and the earth laid up to the roots of the plants, by which means they soon send out luxuriant shoots.

Black thorn hedge.—A cheap fence may be constructed with this plant, in exposed situations, where the white thorn would not thrive. Full grown sloe, or black thorn plants, are set pretty thick, and mixed with hazel, withy, large briar, &c. the tops being cut off to the height of three feet, on a bank raised from two to three feet, with ditches of sufficient depth; but this method should only be adopted in bleak situations. In such situations, however, the black thorn, which abounds in most places, with the assistance of the briar, soon forms a close and impervious fence.

Beech hedge.—As the beech plant seems to resist the effects of sea air, it is found suitable for such situations where the white thorn does not thrive. The bank for a beech hedge should be six or seven feet high, and four or five wide at the top. The young plants are set in two or three rows, at the distance of a foot from each other, and sufficiently thick in the rows. A ditch is seldom required, but the bank or mound is supported by a low stone wall. The beech grows rapidly, and soon forms an excellent and beautiful fence; and, besides, it affords shelter to a late period of the season, while the profit is considerable, from the alternate cutting of one of the rows, when they come to maturity, while the others are plashed or trimmed, yielding wood for fuel or other purposes. This kind of hedge is attended with one inconvenience, that it requires a large quantity of earth for the bank.

Furze hedges.—In similar situations, furze, or whins, are often employed for a fence. By sowing the seeds thick, on high and broad banks, with ditches on the sides, the young furze grows easily and quickly. To guard against the thinness produced by the decay of the old parts of the plant, the best method is to cut them close down, first on one side and then on the other, every two or three years. The broad bank recommended admits of this management, and a fence always remains on one side or the other, in some degree of perfection. In situations where fodder is scarce, the bruised cuttings may be employed as food for animals. But a hedge of this kind ought only to be adopted as a substitute in places where other plants do not succeed; for it requires a large space of ground, and the seeds scattered over the inclosures soon fill them with plants, which are not easily eradicated.

Diseases of hedge plants.—On certain soils, as on cold wet clay, the white thorn, as well as other woody plants, are apt to be covered with moss, which greatly impedes their growth, and, as it increases, entirely destroys them. In planting young hedges, it has been recommended to prepare the soil by manuring it; and if a sufficient quantity of lime be incorporated with the earth, the young hedge is secured from this malady. To recover old hedges from this evil, and render them good fences, they should be cut down close by the surface, cleared of weeds, and the earth well dug to the extent of half a yard on each side. After this operation, which should be performed about the end of autumn, the spaces which have been dug are to be well limed on the surface, and remaining in that state during the winter, the earth should be dug again early in the spring, and the lime well mixed with the soil. Where this method has been properly practised, the plants push out vigorous shoots, which soon form good hedges, and the moss no longer appears. The use of lime in the same way is recommended as a certain remedy to destroy moss on other kinds of trees.

Hedge-row of trees.—Hedge-rows, planted in the direction of the live fence, are recommended by some as affording shelter and beauty to a country; but al-

Fences.

though this practice is by no means uncommon, especially in England, it is objected to by others, because it deprives the fence of part of its nourishment, and greatly injures the plants by the shade, as well as by the drop, in rainy weather. Where hedge-rows accompany stone walls, and when they attain a considerable size, they are shaken by strong winds, by which the wall is loosened and cracked, and requires constant repair. But the inconvenience is not confined to the fence only. The drop and shade of such trees, when the branches extend to any great length, are also injurious to the corn and herbage crops. But it rarely happens that trees planted in this way arrive at any great size to afford such emolument to the proprietor as may counterbalance the disadvantages with which they are attended. Hedge-rows, therefore, may be considered more as an ornamental than an useful improvement.

Compound hedge fences are of different kinds, as a single hedge and ditch, with or without paling; hedge and bank; hedge with post and rail; hedge and wall fence, and some others; and paling or timber fences are constructed either with simple nailed, jointed, horizontal paling; upright lath paling; horizontal paling of young firs; paling of growing trees, or rails nailed to growing posts, and others of the same description:—but for a particular account of such fences, we refer to Dickson's System of Agriculture, or to the General Dictionary of Agriculture and Husbandry.

Wall-fences are either constructed of dry stone, of stone and lime, of brick, or of turf.

Dry-stone wall.—Walls of this description are sometimes constructed by common labourers, with round stones, collected from the fields, and coped with sod. Sometimes they are made with quarried stones, brought somewhat into shape. Of fences of this description, the Galloway dike, so called from being extensively used in that district of Scotland, seems to be in most repute.

Galloway dike.—This kind of fence is not uncommon in many parts of Scotland, and in some parts of England; and it seems well calculated for inclosing high grounds pastured with sheep. It is regularly and compactly built with dry stones, in the same way as a dry-stone wall, with a broad base, and tapering gradually upwards to the height of two feet, or two feet and a half. The building is then levelled with a course of flat stones, resembling a coping. These flat stones project two or three inches over the wall on each side. A course of rugged round stones succeeds, and they are placed upon each other in a way sufficiently secure for the stability of the building; but so open as to allow a free passage to the wind and light. The rough open part of the building is usually raised three feet above the regular part, and gradually tapers upwards till it terminates in a top of nine inches broad; every course of the rough stones being smaller than that immediately below it. The tottering appearance of this wall prevents every kind of animal from approaching it; so that, where stones fit for the purpose are abundant, it becomes a valuable fence. In many places where the fields are covered with large stones, the expence of a wall of this kind but little exceeds the mason work; but the expense must vary according to the price of labour, and the facility or difficulty of procuring stones. This fence answers equally well, if not better than more expensive fences, in most situations, where the confinement of the stock, or the protection of a crop, are the principal objects. But it affords neither shelter nor ornament to the country; so that it seems most eligible in lower districts, where land is valuable, and little shelter is required.

Stone and lime walls.—To render walls of this kind durable, they should have a good foundation, deep enough to prevent the effects of frost, with a broad base, gradually tapering upwards. Next to hedges, this is the most durable fence; but it is expensive, and possesses few advantages over the dry-stone wall. Stones from the quarry are always to be preferred to land stones. Like other stone fences, it ought to be secured at top with a substantial coping of stone and lime. Flag-stones, inclining towards each other, and meeting at the top, with the intermediate space filled with small stones and mortar, forms a most durable coping, which, from its wedge-like shape, and solid, impenetrable surface, seems well calculated for the preservation of the building. The end of spring, the summer months, or the early part of autumn, are the best seasons for such operations.

Stone and clay walls.—In the construction of such walls, the clay is employed as a substitute for lime; and in the dry stone wall, lipped with lime, the difference from the ordinary wall, in having about two or three inches on each side lipped with lime, which gives it the appearance of an entire building of stone and lime; but it is found to be little more durable than the common dry stone wall. Walls of this latter description are sometimes dashed with lime after the work is finished; which adds something to their appearance, but contributes little to their utility. Dry stone walls are primed and harled, by filling up every vacant space on the outside of the building, and harling afterwards, which gives a finished appearance, and produces a durable fence.

Frame-walls.—The construction of such walls is accomplished, by preparing a frame of deal-boards, of the intended width and height of the fence. A foundation is dug; the frame is placed upon the line, and filled with stones of all kinds, collected from the fields. When the frame is filled to the top, liquid mortar is poured in to fill up the interstices, and the whole remains in that state till the mortar has acquired a sufficient degree of firmness to give stability to the building. This is accomplished in a day or two, during the warm and dry weather of summer; the frame is then removed, carried farther along the line, and the same operation is repeated. In this way the whole line of fence is gradually completed, and, with well-tempered lime, and proper attention to incorporate it with the stones, the wall presents a smooth surface, with a firm and substantial appearance.

Every kind of stone-wall possesses considerable advantages. The inclosure is completed at once; little space is occupied, so that a considerable portion of land is saved; and even that part near the sides of stone walls, which is usually waste, may be profitably employed in raising grain, potatoes, or other vegetables. But these advantages are accompanied with some defects. The most substantial fences of this kind are more or less perishable, according to the materials employed and the mode of construction. After a certain time, the attention and expense to keep them in repair are considerable. They afford but little shelter, and are rather a deformity than an ornament to the country.

Chap. III. Of Soils.

Soil is the layer of loose, earthy matters, which constitutes the upper covering of the globe, affords a station to the roots of innumerable tribes of vegetables, and supplies them with nourishment to promote their growth and bring them to maturity. It consists of the primitive earths which enter into the composition of the prevailing strata or rocks, from the disintegration of which it is obviously formed. The succeeding layer, on which the vegetable soil reposes, whatever be its nature, whether it be composed of less coherent or more solid materials, is usually distinguished by the name of under-soil, or *subsoil*. In treating this subject, the formation, composition, and classification of soils may be considered.

Sect. I. *Of the Formation of Soil.*

The formation of soil is a beautiful natural process, which is accomplished by the combined influence of moisture and vegetable action on the solid strata of the globe. The changes which take place in this process succeed each other with more or less rapidity, according to the nature of the rocks, and the power of the agents which operate in their decomposition. In a warm country, and a moist climate, where vegetation is powerful and vigorous, it proceeds with astonishing rapidity; but in the colder regions of the earth, it advances with slower and more progressive steps. But, whatever be its progress, the hardest rocks, as well as those of less durable or less coherent materials, are subject to disintegration and decay, and contribute to the formation and increase of soil.

First process.—It is not difficult to trace the steps of this process, by observing what is daily going on around us. A bare rock, when it is uncovered, or a mass of stone which has been lately dug from the quarry, when fully exposed to the air, soon loses its fresh appearance, and assumes a different aspect. When the change that has taken place is investigated, it is found that the surface of the stone is covered with a thin crust, of a substance very different in its nature from the stone itself. A closer inspection shews that this crust is a vegetable production, belonging to the tribe of plants known by the name of *Lichens*, and supposed, perhaps from ignorance or inability to examine them, to be less perfect in their structure than other plants. The seeds of plants of this description are extremely minute, easily wafted about by the wind, and, floating in the atmosphere, attach themselves most readily to those bodies which are somewhat moist. Porous rocks, which are most apt to absorb moisture from the earth or from the air, are the first on which lichens make their appearance. By means of this vegetable covering, a larger portion of moisture from the atmosphere is absorbed, and a smaller portion of what rises through the rocky mass from the earth is lost by evaporation. This affords additional nourishment, and increases the power of vegetation. A thin layer is soon detached from the surface of the rock, and reduced to the earthy form. The first vegetable productions, in the changes of the seasons, decay; and hence the first thin stratum of soil is formed by the decomposition of the vegetable matter, and the disintegration of part of the mass of stone on which it was produced. Plants of a larger size, and more vigorous growth, whose seeds are carried about in the air, find a fit receptacle in this mixed mass of matter for their vegetation and growth. They, in their turn, decay, and contribute a fresh portion of vegetable substance, while another accession of earthy particles, derived from the stone, is made to the general mass. Insects and worms, which make their abode in the earth or on plants, in the progressive changes to which they are subject, and in the various stages of their existence, deposit animal remains in the places which they frequent, serve also to increase the quantity of organized matter in the new soil. Tracing the progress of the formation of soil in this way, we may see how a thick bed is prepared, which shall, in time, be fit for the reception of the largest plants.

Every kind of rock, even of the densest and hardest nature, is subject to this change. The purest rock-crystal when exposed to the weather, in no long period is deprived of its brilliant lustre and fine polish; but the extent and rapidity of the change correspond with the nature of the rocky mass and the heat and moisture of the climate. In the warmer regions of the earth, the surface of a bare rock is soon converted into friable, earthy matter, covered with verdure, and clothed with trees; but in colder climates, or in more elevated situations, the process is slower as well as more limited. The vegetables which spring up are of smaller magnitude, and of a diminutive growth, and thus afford a more scanty supply to the production of soil.

Diversity of soil.—The diversity of earthy matters contained in the soil, depends on the nature of the constituent parts of the rocks from which it is derived. Rocks in which the prevailing constituent is siliceous earth, afford a sandy soil; these rocks in which alumina, or pure clay, is predominant, yield a clay soil; lime abounds in the soil which is formed in the vicinity of limestone-rocks; and the just proportion of these earths, which may be considered as the basis of a good soil, is derived from those rocks in which they naturally exist.

Carse soil.—But the soil, as it is formed by the disintegration of rocks, does not always remain on the spot from which it originated. It is carried by rains and floods, from the higher to the lower ground, where it is deposited, and, in a succession of ages, forms a thick bed. When the earthy matters are swept away by rivers with a slow current, they are deposited on their flat banks, or at wide estuaries. In this way some of the richest soils have been formed. The fertile lands at the mouth of the Nile, and

Of Soils.

the flat grounds in the vicinity of the Forth and the Tay in Scotland, well known by the name of *carse lands*, are of this description.

Gravelly soil.—Gravel, which abounds in many soils, and constitutes entire beds, derives its origin from those rocks whose lofty precipices are exposed to the weather; but especially from such rocks as contain many fissures and cavities, and admit and retain water. This water, when it is near the surface, is frozen during the winter, and, by its expansive force in the state of ice, tears off and throws down immense masses of the rock. These masses, broken down in their fall, are reduced to pieces of still smaller magnitude by the current of rivers, or the agitation of the waters of lakes, or of the ocean. In the progress of those changes which the face of the earth everywhere exhibits, the river changes its course,—the sea recedes,—the lake is dried up,—and the bank of gravel becomes dry land. The seeds of vegetables fall on its surface,—grow up, and decay; they are succeeded by other generations, which run the same course; a portion of earthy matter is obtained from the stones on which the vegetable remains are deposited, and being mixed with the loose stones, forms a gravelly soil.

Moorish soil.—The nature of the climate, and water stagnating in low grounds, have a powerful effect in producing a diversity of soil. In elevated situations, the chilling influence of cold permits plants only of a coarse and hardy character to spring up; when they die, the same influence retards or interrupts their complete decomposition; and in such places the soil consists of a mass of half-decayed roots and stems of different species of heath and *carex*, or sedge-grass, with which it is almost entirely occupied. This is the origin of heathy or moorish soils.

Mossy soil.—In places where water stagnates, a different tribe of plants is produced. The bog-moss, or *sphagnum palustre*, first makes its appearance; a new race of the same species succeeds; other species and plants of a different character find a convenient station in the floating mass; and, from the accumulation of innumerable generations of various kinds of vegetables in a state of imperfect decomposition, peaty or mossy soil derives its origin.

Saline matters in soil.—Besides the ingredients already mentioned, which may be considered as the base of soils, other substances enter into their composition. Some of these, as magnesia, which is sparingly met with in soils, and certain metallic matters with which they are frequently impregnated, originally existed in the strata, from the disintegration of which the soil is formed. Saline substances, which are also sometimes found in soils, have the same origin, but are occasionally deposited by the water of springs, as it filtrates through the earth.

Subsoil.—The stratum which immediately supports the soil in which vegetables grow, is distinguished from its relative position by the name of *subsoil*, or undersoil. It sometimes happens, but rarely, that the rock which furnished the materials for the soil constitutes the subsoil; but it consists more frequently of a bed of gravel, or clay, or sand. A knowledge of the nature and character of the subsoil is of no small importance in conducting improvements in agriculture. It is often a guide to the means to be adopted in draining; and in tillage operations, when it is within reach of the plough, it may be avoided, or partially turned up, as the ingredients of which it is composed, when mixed with the soil, seem to be salutary or injurious.

Of Soils.

Sect. II. *Of the Component Parts of Soils.*

The ingredients of which soils are composed, are certain combinations of some of the primitive earths, with organized matter in a decomposing state, along with a portion of iron, and some saline compounds. The proportion of these matters is extremely variable, and from this arises the endless diversity of soils. The predominant earths in soils are, alumina or pure clay; silica, or pure sand; lime, or calcareous earth; and, more rarely, magnesia.

Alumina, or clay, when in a state of purity, is in the form of a white powder; it adheres strongly to the tongue, is insoluble in water, but soluble in acids, and in watery solutions of the fixed alkalies. It is the prevailing earth in clay soils, in which it is generally of a reddish colour, from an impregnation of the oxide of iron.

Silica, or the earth of flints, or pure sand, when in a state of perfect purity, is also in the form of a white powder. It is infusible in the fire, and insoluble in water, and almost all the acids. Sandy and gravelly soils, and hard stony lands, are chiefly composed of silica.

Lime is obtained from the burning of limestone, in which state it is known by the name of quicklime. As it exists in soils, it is commonly in combination with carbonic acid, or fixed air. It is also in the form of a white powder, when it is perfectly pure. Chalk is limestone, with a slight degree of coherence; and marble is the same substance in its most compact form. Gypsum, or plaster of Paris, is lime in combination with sulphuric acid, or oil of vitriol; and phosphate of lime is a compound of lime and phosphoric acid.

Magnesia, in a state of purity, is a white, light powder, which is soluble in acids, but not in alkaline solutions. It is a rare ingredient in soils; but when it appears, it is in combination with carbonic acid, or with some of the earths.

The saline matters which have been detected in soils are, common salt, Epsom salt, muriate and sulphate of potash, nitrate of lime, and some of the alkalies; but they exist in very small quantities, and their occurrence is rare.

Rust of iron, or ochre, or oxide of iron, is met with in almost every soil; but in the red and yellow clay soils, and the red and yellow siliceous sands, it is in greatest abundance.

Vegetable and animal matter, in a state of decomposition, forms an essential ingredient in all good soils. Vegetable matter exists in very different states, contains a large proportion of carbonaceous substance, and yields no volatile alkali. It is the chief ingredient in peats, and is abundant in rich moulds. The state of animal matter in the soil is as different as the substances from which it is obtained. It usually contains less carbonaceous substance than vege-

Of Soils.

table matters; and, when exposed to heat, affords ammonia, or volatile alkali, and carbonic acid. It is abundant in soils to which manure has been lately applied.

A fertile soil in the vicinity of Turin, analysed by M. Giobert, contained, in a pound weight, from 20 to 30 grains of extractive matter, which flamed and burned, and 70 grains of water, and about 19 grains of air, one-third of which was carbonic acid, and the rest heavy inflammable air. It yielded no volatile alkali. The earths existed in the following proportions in 100 parts:

Silica	from 77	to 79
Alumina ——	9	— 14
Lime ——	5	— 12

In a less fertile soil, the proportions were found to be,

Silica	from 48	to 80
Alumina ——	7	— 22
Lime ——	6	— 11

And in soils accounted barren, the proportions appeared to be,

Silica	from 42	to 88
Alumina ——	20	— 30
Lime ——	4	— 20

But, if these analyses be correct, the difference between rich and poor soils must depend more on the proportion of organized matter existing in them, than on the diversity of the earthy ingredients.

The more improved state of chemical science, and the ingenious researches of Sir Humphry Davy, have enabled that distinguished philosopher to throw a clearer light on the nature and properties of soil. The following are the results of his analysis:—A good turnip soil from Norfolk afforded eight parts out of nine of siliceous sand. Of the finely divided matter, 100 parts consisted of,

Carbonate of lime -	63
Silica - - -	15
Alumina - - -	11
Oxide of iron - -	3
Vegetable and saline matter	5
Moisture - - -	3

A soil in which oaks grow vigorously, taken from a field in Sussex, was composed of six parts of sand, and one part of clay and finely divided matter. A hundred parts of the entire soil, analyzed, yielded,

Silica - - -	54
Alumina - - -	28
Carbonate of lime -	3
Oxide of iron - -	5
Decomposing vegetable matter	4
Moisture and loss - -	6

An excellent wheat soil from Middlesex afforded three parts in five of siliceous sand. The finely divided matter was composed of

Carbonate of lime - - -	28
Silica - - - -	32
Alumina - - -	29
Animal or vegetable matter, and moisture	11

In his remarks on these results, Sir Humphry Davy observes, that the first soil examined possessed the least, and the last the greatest cohesive property; that the finely divided matters, in all cases, give tenacity to the soil, and this quality depends on the proportion of alumina; and that a small quantity of finely divided matter fits a soil for turnips or barley, 11 parts sand out of 12 yielding a good crop of the former; that a much larger proportion of sand induces absolute sterility, as in the soil of Bagshot-heath, which has no vegetable covering, 400 parts heated red yielding 380 parts coarse siliceous sand, 9 parts fine siliceous sand, and 11 parts impalpable matter, which was a mixture of ferruginous clay and carbonate of lime; that the vegetable or animal matters, when finely divided, give coherence, softness, and penetrability; that none of the ingredients of a soil ought to be in too great proportion; that a soil composed entirely of impalpable matters is unproductive; that none of the earths in a state of purity, as alumina, or silica, or carbonate of lime, or of magnesia, is capable of supporting healthy vegetation; and that no soil whatever is fertile when it contains 19 parts out of 20 of any of its ingredients.*

Analysis of soils.—It would be of little use to the practical agriculturist, who is not always an experienced chemist, to enter into a minute detail of the method of analysing soils. For this information we refer to CHEMISTRY, or to Sir Humphry Davy's work already quoted; and we shall here notice some of the simpler processes from which a knowledge of the constitution, character, and more essential properties of soils, may be obtained.

In whatever way a soil is to be examined, whether by a ruder, or a more minute and accurate method, specimens of it should be collected from different places of the field, and two or three inches below the surface; and it should be carefully observed whether these different specimens possess similar properties. On extensive plains, the whole of the soil is found to be pretty uniform in the nature and proportion of the ingredients of which it is composed; but in vallies, and near the beds of rivers, which are supplied with materials of the soil from the higher grounds, and these being very different in their nature, great diversity of soil prevails. One part of the field is covered with a calcareous soil, and another part is siliceous. The specific gravity of a soil is an indication of the quantity of organized matter which it contains; for such matter is most abundant in lighter soils. To ascertain the specific gravity of soil, an equal bulk of water and of soil may be introduced into a phial of a determinate capacity. If a bottle containing 400 grains of water be half filled with that liquid, and if the remaining half be filled with the soil to be examined, and if the bottle gain 200 grains of weight more than when it is entirely filled with water, the specific gravity of the soil is double that of water, or 2. The colour, feel, and some other physical properties of soils, may in some measure lead to a knowledge of their composition. A siliceous soil is rough and hard to the touch, and when rubbed on glass scratches it. A red or yellow colour denotes a ferruginous soil; and softness is one of the characteristics of a calcareous soil.

* Elements of Agricultural Chemistry, 154.

Of Soils.

The power of absorbing and retaining heat and moisture, seems to be closely connected with the fertility of the soil. Certain soils are more easily heated than others, and when brought to the same degree of heat, cool more rapidly. A soil of a stiff white clay is heated with difficulty; and from the moisture it contains, retains the heat but for a short time. A chalk soil is also heated with difficulty; but, containing less moisture, the heat is retained longer. A black soil, in which soft vegetable matter is predominant, is most heated by the sun and air. Deep coloured soils, and such as contain a large proportion of carbonaceous and ferruginous matter, exposed to the sun, acquire a higher temperature than soils of a pale colour. A rich black mould, containing nearly a fourth of vegetable matter, exposed to sunshine, increased in temperature, in the space of an hour, from 65° to 88°; but a chalk soil, under similar circumstances, was heated only to 69°. The mould being removed into the shade, where the temperature was 62°, in half an hour lost 15°; while the chalk soil, in the same situation, lost only 4°. A cold fertile soil, and a cold barren clay, being previously dried, were heated to the temperature of 88°, and afterwards exposed to a temperature of 57°; the brown soil lost in half an hour 9°, while the clay had lost only 6°. An equal portion of the clay, containing moisture, was heated to 88°, and then exposed to a temperature of 55°; in a quarter of an hour it gained the temperature of the room. In conducting these experiments, which were made by Sir Humphry Davy, the soils were placed in small tinplate trays, two inches square and half an inch in depth.

Absorption of moisture.—The temperature of the soil, or its power of combining with and retaining heat, is greatly modified by the property of absorbing and retaining moisture; and the power of the soil to absorb water, depends, in a great measure, on the state of division of its parts; for the more they are divided, the greater is its absorbent power. This power is greater in vegetable than in animal substances; the latter possess it in a higher degree than compounds of the earths, and a considerable diversity prevails in the different proportions of the earths themselves.

The fertility of a soil depends much on its power of absorbing water from the atmosphere. Soils possess this power in very different degrees, and it is always greatest in the most fertile soils. Experiments can be easily made to ascertain this property; so that it affords a simple method of determining the fertility or barrenness of land. We shall quote the experiments of Sir Humphry Davy on this subject. 1000 parts of a rich soil from Ormiston in East Lothian, containing more than half its weight of finely divided matter, of which 11 parts were carbonate of lime, and nine parts vegetable matter, were dried at the temperature of 212°, were exposed for an hour to air at 62°, and saturated with moisture, and gained 18 grains. 1000 parts of a fertile soil from Somersetshire, treated in the same way, gained 16 grains; 1000 parts of a soil from Essex gained 13 grains; 1000 parts of fine sand from Essex gained 11 grains; 1000 parts of the soil of Bagshot-heath increased only three grains in weight *.

Proportion of organised matter ascertained.—An easy method of discovering the comparative proportions of organised matter in soils, is recommended by Dr Coventry, in his Lectures on Agriculture. This method consists in the simple process of deflagrating a certain quantity of the soil with nitre. In conducting the experiment, a determinate quantity of nitre is fused in a crucible, and while in that state the dry soil is projected upon it, in divided portions. The addition of the soil is continued till the deflagration, or sudden inflammation, which takes place when any carbonaceous matter comes in contact, ceases. Suppose it requires one ounce of a fertile soil to produce this effect, and that it requires two ounces of a different soil to produce the same effect, it follows that the latter soil contains only one half the proportion of carbonaceous matter which exists in the former, and therefore it must be greatly inferior in fertility.

Uses of earthy matters in soils.—Besides affording a station to plants, the earths which enter into the composition of soil have a kind of mechanical action in retaining water, and supplying it in proper proportion to their roots; they also tend to the equal distribution and supply of the vegetable and animal matter for their nourishment. But there seems to be some degree of chemical affinity between the earths and the earthy carbonates, and some of the principles of vegetable and animal substances. If an acid solution of alumina or pure clay be mixed with a solution of soap, the alumina unites with the oil of the soap, and forms a white powder, which sinks to the bottom of the liquid. When pipe-clay or chalk is boiled with the extract of decomposing vegetable matter, the compound formed renders the decomposition and solution of the vegetable matter more difficult. Siliceous sands have little effect in this way; but the soils which have the greatest chemical power in preserving manures, are those in which alumina and carbonate of lime are the predominant earths. Such soils are well characterised by the name of rich soils; while sandy soils are properly denominated hungry, because they have little or no affinity for the organised matters which are soon carried off by water or dissipated in the atmosphere. The black and brown rich vegetable moulds are supposed to be combined with a peculiar extractive matter, derived from the decomposition of vegetables. This matter is slowly taken up by water, and appears to be one of the chief causes of the fertility of the earth †.

Effects of the sub-soil.—Soils which repose immediately upon a stratum of rock or stone, become much sooner dry by the process of evaporation, than when the sub-soil is of clay or marl. The contiguity of the rocky strata to the soil, is supposed to be one of the principal causes of the remarkable fertility of the land in the humid climate of Ireland. A sub-soil in which clay predominates is sometimes highly beneficial to a sandy soil, in aiding its deficient absorbent power, and supplying the moisture which is lost by evaporation and the consumption of plants; and, on

* Elements of Agricultural Chemistry, p. 161. † Ibid. 262.

the other hand, the excessive degree of absorbent power in a soil, is often corrected by a sub-soil of a sandy or gravelly nature. In calcareous countries, where the surface appears to be a species of marl, the limestone is only a few inches from the soil; but the contiguity of the rock impairs not its fertility, although a less absorbent soil would, in such circumstances, be rendered sterile. This is finely exemplified in the appearance of the sand-stone and limestone hills in Derbyshire and North Wales during the summer season; the grass of the former usually exhibits a brown and parched aspect, while the latter are clothed with a rich verdant covering.

Plants indicate the nature of the soil.—The method of judging of the nature of soil, from the growth and character of plants, which is sometime had recourse to by practical persons who have little knowledge of botany, might, we apprehend, be greatly improved, by more extensive and more accurate observation. When plants, which are the natural productions of a good soil, appear in a healthy and flourishing state in other situations, it may be concluded that there is a near resemblance in the two soils. Thus, for example, the thistle of different species is a mark of a good soil; the dock grows in an inferior soil, of the stiff kind; the nettle prefers that of a dry, loamy description; the common rush appears only in a wet, cold clay soil; the fox-glove [*digitalis purpurea*] affects a sandy and gravelly soil, and the common fern, [*pteris aquilina*] shoots up only from a deep rich soil. It has been suggested, that a catalogue of such plants as grow spontaneously in different situations, might be useful in determining the fertility and properties of soils, in the same way that the period of flowering in different climates denotes the temperature of the season. The growth and healthy aspect of different kinds of forest trees, may be also employed as a pretty good test of the nature of the soil; and the sudden decline and decay of trees, particularly of *fruit* trees, after thriving well for some time, shew that the roots have reached a cold wet sub-soil, which is unfriendly to healthy vegetation. The luxuriant growth of the quick thorn hedge, may be regarded as a certain indication of a good dry soil.

Sect. III. *Of the Classification of Soils.*

The different ingredients which enter into the composition of soil, and the great diversity of the proportions of these ingredients, must obviously give rise to an endless diversity of soils, which have been distinguished by various names, derived sometimes from the supposed predominant material, sometimes from the colour, and sometimes from the texture or coherence of the particles of which they are composed. No attempt which has yet been made to classify soils can be considered as altogether unexceptionable; and perhaps a successful arrangement of this kind, if the nature of the subject admit of it, is only to be accomplished in the progressive improvement of chemical science. But for practical purposes, the classification of soils which has been usually adopted, may be considered as sufficiently precise. Soils have been usually divided into clayey, loamy, chalky, gravelly, sandy, boggy, mossy, or peaty, and heathy or moorish soils.

Clayey soils.—Clay is never found in a state of purity in any soil, so that the name given to a soil of this description must denote the predominance of this ingredient, or the character which it communicates to the soil. And indeed it seems probable, that some soils, which have the property of absorbing and retaining moisture, or of becoming soft and ductile with water, may derive this peculiar character from a smaller proportion of clay than is usually supposed. The clayey soils of some districts, it has been observed, are very fruitful and productive, while those of others are extremely barren and unmanageable. In such cases, a remarkable diversity in the nature or proportions of the constituent parts must exist; and this, it is evident, must direct to different processes, and different applications, for their improvement. But whatever be the constitution of a soil of this nature, it invariably requires greater power, labour, and attention, to bring it into a condition suitable for improvement and the production of good crops than almost any other. Such soils, from their cohesive nature, are usually barren. In wet seasons, the plants which grow in such soils are chilled with excessive moisture, and in dry seasons the tender roots are unable to penetrate the solid ground. The vigorous appearance of the vegetable productions of such a soil, affords a pretty good proof of its fertility; but if they appear languid and stinted in their growth, the soil is cold and barren. The thinner kinds of lands of this description are almost universally poor, and such land is ill adapted for the plough, either in winter or summer; for it cannot resist the alternatives of frost and rain in winter; and if it should be a wet season before seed-time, the prospect of a crop is doubtful; and if ploughed late in spring, the whole depth of the soil is parched during the dry season, and the grain is deprived of nourishment. The end of February, or the beginning of March, is the proper time for ploughing such land.

Improvement of clayey soils.—Many of these soils are capable of essential improvement by the judicious application of manure, and a proper course of management. For the purpose of altering and improving the texture of a clayey soil, limestone or marl is found to be the most efficient substance. Gravel also has been successfully applied in some cases, with the same view; but where these mineral matters cannot be obtained in sufficient quantity, a mixture of dung and sand, and especially of sand from the sea shore, greatly contributes to its fertility. Various other substances, such as composts of chalk and dung, tanners' bark, and other materials, which are fancifully supposed to promote a strong fermentation, have been advantageously employed. Gravel from neighbouring soils, sea or pit coal ashes, rubbish of old buildings, and peat-ashes, are useful ingredients in enriching clayey soils. In cases where a clayey soil contains little or no animal or vegetable matter, and when it also appears to be equally deficient of calcareous matter, a large proportion of dung is the requisite ingredient for its improvement; but where this cannot be procured, a preparation of peat, with a moderate proportion of lime, is the best application. But where such means of improvement are wanting, the growth of pasture grasses should be encouraged and promot-

Of Soils.

ed, for the purpose of supplying it with the necessary quantity of organised substances.

Loamy soils.—The materials of which soils of this description are chiefly composed, are clay, chalk, sand, and gravel, with variable proportions of organised matter. Some of these soils are stiff and compact, while others are loose and porous, and hence they have been distinguished by the names of *heavy*, *stiff*, and *light* loams; and, from the predominance of the ingredients they have been denominated *clayey* loams, *chalky* loams, *sandy* loams, and *gravelly* loams. The first of these is a moderately cohesive soil, in which the argillaceous material predominates. It has less coherence than pure clay, but greater than any other loamy soil. The chalky loam is less cohesive than the former; it is composed of clay, coarse sand, and chalk, and the calcareous ingredient predominates. The sandy loam is composed partly of coarse and partly of fine sand, and is less cohesive than the two former. Gravelly loams, as the name imports, contain a larger mixture of coarse sand or gravel, and, when the soil happens to be shallow, this variety, as well as the two last, come under the denomination of *hungry* soils. Some of the light loams have been distinguished by the name of *sharp lands*.

Improvement of loamy soils.—Soils of this description are improved with greater facility, and at less expense, than those of a clayey nature. Those of the heavier and more adhesive kinds, require a compost of lime and dung, or lime in combination with animal matters, as ground bones and blood. Loams near the banks of rivers, or the sea-coast, are usually so fertile as to demand less aid from manure; but, in general, manure proper for such soils must be varied according to the proportions of the ingredients they contain, or the different degrees of their fertility. Loamy soils, when properly managed, are capable of yielding almost every kind of crop, and not only those of the grain and root kind, but also pulse, hemp, and flax.

Chalky soils.—Extensive tracts in some of the southern districts of England, are occupied with chalky soils; and here, as well as in others, a considerable diversity prevails, both with regard to the thickness and constituent parts of the soil itself, and the nature of the subsoil. When the clayey and loamy ingredients are predominant, the heavier kind of chalky soils are formed; but sand or gravel abounding, constitutes the lighter chalky soils. When the quantity of earthy matter is small, and not reduced to the state of perfect mould, the soil is poor and thin; but where the thickness of the superficial layer is considerable, and the organized matter is almost entirely decomposed, the soil is rich and heavy. When the subsoil is compact, and blended with siliceous matter, it is less favourable to the fertility of the soil than when it is of an open or brittle nature.

Improvement of chalky soils.—Vegetable matters, deposited and accumulated in wet or swampy situations, are beneficially applied to the thinner or lighter calcareous soils. The addition of sandy and clayey loams to those of a heavier description, alters, and greatly improves their texture, and the same good effects are obtained from the use of composts of vegetable and animal matters, farm-yard manure, and ashes, soot, and malt dust. The proper season for breaking up such land should be particularly attended to; for if the operation be deferred till dry weather, the soil becomes so hard as to be almost unmanageable, till it be softened by the rain.

Of Soils.

Gravelly soils.—Soils which come under this denomination are very different, according to the nature of the earthy matters which enter into their composition, and the size of the stony particles from which they derive their characteristic property. These stony particles vary in magnitude, from the size of the smallest pea to that of the egg of a pullet. When they are larger, the soil is denominated a *rocky* soil. Beds of gravel are chiefly composed of siliceous or calcareous matters, while the rocky and stony substances are of different qualities. In some cases, the gravelly mixture has been found to approach nearly to the surface, while, in others, it is at a considerable distance below it. Where the stratum of gravel is near the top, a full crop of broom covers the ground, when the land is under grass; and a crop of sheep sorrel is equally abundant when it is in tillage. Sometimes springs are observed to burst out near the surface, at other times they can only be discovered at a great depth. A similar diversity prevails in the subsoil, consisting sometimes of rocky masses, and sometimes of clay, of rocky gravel, or sand. From the porous nature of gravelly soils, they readily absorb moisture, and with the same facility part with it, from which it happens that, in dry seasons, they exhibit a parched and withered aspect.

Improvements of gravelly soils.—The materials to be added to gravelly soils of a calcareous nature, to increase their fertility, are clay and clay loam. A mixture of carbonate of lime or chalk, with clay, has also appeared beneficial to such soils. Chalk is particularly recommended for those kinds of gravelly soil which contiguity to springs is apt to render moist in the winter season. The application of chalk is stated as having a powerful effect, not only in counteracting the redundant moisture, but in correcting the tendency to become parched in the summer, an evil to which most gravels are in some degree liable, and which is often so injurious to the crop.

The defect of vegetable and animal matters is to be supplied by means of dung from the farm-yard, in its reduced state; and much benefit is derived from other animal matters, prepared in the form of composts, with good loamy mould, ashes, clay, depositions of rivers and ponds, with other substances of a similar nature. The proper alternation of green vegetable, and other crops, also contributes greatly to improve the fertility of such lands.

Sandy soils.—The varieties of soils of this description depend on the nature of the rocks from which they derive their origin, and the different proportions of other matters of which they are composed. In some districts, soils of this kind are found, varying from the lightest species of loam to the naked sand, composed almost entirely of small siliceous particles; but the proportion of other earthy matters renders them more or less favourable to vegetation. When that proportion is nearly equal to the sand, the mixture affords the heavier kinds of sandy soils; but when they are in smaller quantities, a light sandy soil

Of Soils.

is formed; and when composed entirely of siliceous particles, it constitutes a loose blowing sand, usually of a white or brownish appearance. The variety of texture and composition in such soils, is closely connected with the power of absorbing and retaining heat and moisture.

Improvement of sandy soils.—The want of coherence is one of the chief defects of sandy soils. This defect is supplied by the application of clay or loamy substances; and the other great defect, the want of animal and vegetable matters, is to be supplied by the free use of dung. For this purpose, clay and loam, either alone or in the form of compost, with animal and vegetable manure, or good mould, or peaty earth, either alone or in combination with other substances, may be successfully employed. It is scarcely necessary to add, that the proportion of ingredients to be applied, must correspond with the quality of the soil to be improved. The treading of sheep, folded upon sandy soils, has been found to increase their tenacity and firmness, while the dung and urine of these animals contribute much to their fertility. The author of the Agricultural Report of East Lothian, observes, that "considerable tracts of this soil, formerly of little value, have been brought under the plough, and made to produce excellent crops of turnips, clover, barley, rye, &c.; but the most valuable improvement on this description of soil has been made by laying it into grass, and treating it with top-dressings of different kinds of soils, which, when liberally applied, have, in not a few instances, changed the appearance, and so much altered its nature, as to render it capable of bearing a succession of valuable crops of grain."

Boggy soils.—Soils of this description chiefly exist in low confined situations, are frequently met with in Ireland, and sometimes in low meadows in the vicinity of large ponds or lakes in this country. The formation of these soils depends on the gradual decay and deposition of the more luxuriant aquatic vegetables, and the stagnation of water, by which their roots are destroyed and reduced to the state of earth; the state of putrefaction and decay to which the plants have advanced, and the nature of the earthy materials with which they are mixed, diversifying their appearance with regard both to colour and texture. Sometimes the colour is of a lightish brown, when the fibrous and ligneous matters have been but slightly changed; but when the process of decomposition has proceeded farther, they become of a dark or black colour.

Improvement of boggy soils.—Draining is the first obvious practice in the improvement of such soils, while the application of chalk, gravel, sand, or shell-marl, serves to bind and correct their texture. Paring and burning has been sometimes employed with advantage; planting such vegetables as have spreading roots, counteracts the excessive porousness of boggy soils; and flooding, where water is within reach, has been successfully practised. Soils of this description have been sometimes converted into meadow pasture, with the best effects, when other means of improvement had failed.

Mossy and peaty soils.—Considerable tracts of country in the northern parts of Britain, and in many parts of Ireland, are covered with this kind of soil, which varies in its qualities, according to the diversity and proportion of the ingredients which enter into its composition. When the vegetable material is in small proportion, the lighter kinds of peaty soil are formed; but when the peaty matter predominates, the deep and heavy mossy soil appears. The peaty matter is of various depths, and of various density, arising, probably, from original difference in the vegetable substances from which it was formed, or from different stages of its decomposition.

In many of the deep mossy districts, the subsoil is of a clayey nature, over which the mossy matter is deposited in a kind of stratified order. The first layer is usually about a foot thick, and has the appearance of a rich brown earth, from a mixture of the loamy or clayey substance with the vegetable earth; the succeeding layer is of a dark colour, considerable thickness, and of various degrees of density. The uppermost stratum is of a pale colour, and a spongy texture, arising from a less perfect state of decay.

Improvement of mossy soils.—To render mossy soils productive, the first step is, to remove the redundant water by proper draining. But certain precautions are necessary in conducting this operation; for, when the whole of the moisture is suddenly withdrawn, the surface becomes so dry and hard as to resist the action of the spade or plough. The draining, then, must proceed gradually, and as much of what may be called the natural moisture should remain in the soil, till the necessary operations of tillage are completed, and the first crops have so far advanced as to cover the ground, and protect the surface from excessive evaporation.

When moss rests on a good subsoil, and when water can be procured in such quantity, a method of improving such soils by floating away great part of the mossy substance, has been successfully pursued. By this method, a great extent of most valuable land in Blair-Drummond moss, in Perthshire, in Scotland, has been completely reclaimed within the last 50 years, and is now covered with all kinds of luxuriant crops.

But when the moss is shallow, and the inferior soil of indifferent quality, after draining and forming the surface into ridges, in such a way as to allow the stagnant water to pass off, the next object is the application of such substances as shall promote the entire decomposition of the vegetable matter, and improve the texture of the soil. With this view, quick-lime, soapers waste, chalk, marl, shell sand, different gravelly substances, sand, and coarse earthy matters, may be advantageously employed. When the quantity of vegetable matter is abundant, and of coarse quality, paring and burning may be an essential improvement; but the application of earthy rubbish produces powerful effects on such a soil. The species of crop raised on mossy soil, have no small share in promoting their fertility. Plants, as the turnip and potatoe, which have large leaves or branching stems, cover the surface, preclude the action of the air, and retain the necessary moisture.

Heathy or moory soils.—This kind of soil is of great extent in different parts of the kingdom; and although, in many of its characters, it is very difforent from the preceding, it resembles it in some of its properties. Two kinds of heathy soil have been described. The first is of a black, soft, porous nature, is very absorbent, and the stones which are distributed on the surface have the remarkable appearance of being bleached; the process of disintegration seems to be completely interrupted; for they are altogether destitute of the incipient vegetation which is rarely absent from stones of a different quality, or in a different situation. The most prominent quality in this kind of soil is its unaccountable sterility. No methods of improvement yet attempted have been followed with success, or have brought any adequate returns for the requisite labour and expence.

The second kind of moory soil presents very different characters. The vegetable remains are in a dry state, intermixed with earth, have many of the properties common to all vegetables, and, under proper management, may be converted into fertile soil. The stones on this kind of moor land have not the bleached appearance, but resemble those which are found in the best soils.

Improvement of heathy soils.—The proportion of vegetable matter, and the depth of soils of this kind, serve to direct to the proper means of improvement. When the remains of heath and of other coarse plants are abundant, and the thickness of the bed is considerable, paring and burning may prove the most effectual process in the operation, in reclaiming them; but when the soil is shallow, and the quantity of vegetable matter deficient, other means must be adopted. In many cases, quicklime, which destroys the coarse herbage, and promotes the growth of pasture grasses of a superior quality, is highly beneficial. Marl of different kinds may be also applied, with much advantage, to soils of this description. Such soils are also susceptible of great improvement by the application of animal and vegetable matters, as dung and the mud of ponds, in the form of earthy composts, as well as by a judicious alternation of grain and green crops.

Chap. IV. Of Manures.

When land, however rich and fertile it may be, is continued under a course of cropping, without receiving any addition to the soil, it soon becomes less productive, or, in common language, it is exhausted. The value of the produce is at last so greatly diminished, as to afford no compensation for the expence of tillage; and no management can increase it, or restore the fertility of the soil, without the application of certain matters, which are well known by the name of *manures*. Manures, then, are substances artificially mixed with the soil, for the purpose of increasing its diminished fertility. The effects of manure may refer either to the improvement of the texture of the soil, or to the supply of those matters which constitute the food of plants, to the correction of noxious ingredients in the soil, or to the increase of the usefulness of such as already exist in it.

The substances which have been usually employed for the purpose of manures, are either of a mineral, vegetable, or animal nature, certain saline substances, and compounds, formed of two or more of these substances. They have been divided into earthy, putrescent, or putrescible, saline, and compost manures. The nature and properties, with the preparation and application of these substances, shall be treated of in the four following sections.

Sect. I. *Of Earthy Manures.*

The earthy matters which have been employed as manures, are, calcareous earth, clay, sand, loam, &c.

1. *Calcareous earth.*

Calcareous earth, either united with other substances, or in an uncombined state, is extensively applied to the improvement of land; and in many cases it is one of the most essential ingredients that can be mixed with the soil. It is used in the state of quicklime, or lime, combined with an acid in the form of carbonate, as limestone, chalk, sea-shells, or that of sulphate or gypsum, and blended with other earthy bodies, as in the different varieties of marl.

Lime.

Lime, as it exists in nature, is always in a state of combination, and by far the most common compound is that of carbonate, in which it is united with carbonic acid, under the well-known forms of limespar, marble, limestone; and in lime-spar, and the purer kind of marbles, the carbonate of lime is almost the sole constituent; but in limestone, the mineral from which lime, for the purposes of agriculture and of cement, is derived, is rarely free from a certain portion of clay and siliceous earth, and sometimes it is contaminated with metallic matters.

When limestone is subjected to strong heat, the carbonic acid with which it is combined is driven off, and it is found to have lost a portion of its weight equal to the elastic fluid which has escaped. When the burnt mass is exposed to a moist air, it absorbs water, swells, and falls down into a powder, which is lime, or quick-lime, more or less pure according to the purity of the limestone. But the limestone, when it is reduced to this powdery state by calcination and the absorption of moisture, has acquired new properties. Limestone, in the state of the finest powder, has no perceptible effect on animal or vegetable matters, but quick lime is acrid and corrosive; and this is the foundation of the distinctive characters of lime in the two states, under the denomination of mild and caustic. By the calcination of limestone, the object of which is to separate the carbonic acid, it is deprived of from seven to eight parts out of twenty of its weight, or from 35 to 40 per cent., and when it is very pure the loss of weight is nearly equal to one-half the weight of the stone; but it is obvious that this loss of weight must vary according to the variable proportions of other earths. When water is gradually added to fresh burnt lime, great heat is produced, and the water enters into combination with the earth, which is called the slaking of lime, in which process it combines with about one-third of its weight of water.

Analysis of limestone.—As common limestones have

Manures.

very different degrees of purity, it is obviously of great importance to ascertain the quantity of calcareous matter which enters into their composition. In general, it may be observed, that the greater the loss of weight which they sustain in burning, the greater is the proportion of pure lime. A pretty accurate comparative estimate may be made of the quantity of calcareous matter in any limestone, by observing, first, how much diluted nitric or muriatic acid is required for the complete saturation of a determinate portion of a specimen of the purest limestone; and, secondly, by ascertaining how much of the limestone to be examined will saturate an equal portion of the same acid. If, in the latter case, a double quantity is found necessary, then the stone contains only half the quantity of the calcareous earth which is in combination with the purer specimen. The comparative purity of different limestones may be also estimated, by dissolving a small portion of the stone to be examined in muriatic acid, and observing the quantity of undissolved matter, if any remain, and the smaller the proportion of residue which is not acted upon by the acid the greater is the proportion of calcareous matter contained in the limestone. A simpler and more obvious test is generally had recourse to by practical agriculturists, which consists in the comparative measurement of the burnt limestone in the unslaked state, and of the lime in the state of powder after it is slaked, the latter being three times the quantity of the former, when the limestone is of a good quality.

But a more accurate method of analysis may be pursued, according to the following process: Dissolve a determinate portion of the limestone in twice its weight of muriatic acid, diluted with double its bulk of water; filter the liquid, and add a solution of carbonate of potash till the effervescence ceases, and till the taste and smell indicate the excess of the latter salt. The precipitate is carbonate of lime, which, being collected on the filter, is to be dried at a heat below that of redness. Boil the remaining fluid for fifteen minutes; and if any magnesia exist in solution, it falls down in the form of carbonate, when, by similar treatment, its quantity may be ascertained. If any alumina should be dissolved by the acid, it may be detected in the precipitate with the carbonate of lime, by boiling for a few minutes with soap-ley, which dissolves alumina, but has no action upon carbonate of lime.

As carbonate of lime contains a determinate proportion of carbonic acid, which amounts to about 43 per cent., when the amount of this elastic fluid, obtained during the solution of its calcareous matter in an acid, is known, the quantity of carbonate of lime is easily ascertained. If two parts of the acid, and one part of the mineral, be weighed in two separate bottles, and if they are slowly mixed together till all effervescence ceases, the difference between their weight before and after the experiment indicates the quantity of carbonic acid lost; and for every four grains and a quarter of loss of weight, ten grains of carbonate of lime are to be estimated.

The bulk of carbonic acid given out by a determinate portion of carbonate of lime, is estimated, by an ingenious apparatus, described by Sir Humphry Davy. The limestone to be examined is introduced into a bottle with two orifices; a bottle for containing the acid, and furnished with a stop-cock, is fitted by grinding to the upper orifice. From the orifice in the side proceeds a glass tube, to the end of which a flaccid bladder is fixed, which is introduced into another vessel filled with water, and to the side of this vessel is fixed a spout. When the acid comes in contact with the limestone, the carbonic acid, which is driven off, is received into the bladder, and displaces a quantity of water equal to its own bulk. This water is received into a graduated measure, that the amount may be ascertained; and for every ounce measure, two grains of carbonate of lime are to be estimated.

Magnesian limestone.—The constituent parts and action of magnesian limestone on the soil, are very different from those of the common limestone. This variety is very abundant in some of the northern and midland districts of England; and, from its active nature, it is distinguished by the name of *hot lime.* The colour of this stone is usually pale yellow or brown. It effervesces very slowly in acids, and communicates a milky appearance to diluted nitric acid. The component parts of this limestone are from 20 to 22 of magnesia; from 29 to 31 of lime; about 47 of carbonic acid; and a small portion of clay and oxide of iron.

Burning lime.—In the preparation of lime by calcination or burning, a good deal of attention is necessary to the nature of the stone employed. And here the aid of chemistry, in ascertaining its constituent parts, might be highly beneficial. It is stated by Sir Humphry Davy, that one bushel of coal is, in general, sufficient to make four or five bushels of lime; but the proportion of the fuel and the product must vary according to the nature of both. It appears, that the magnesian limestone requires less fuel than common limestone. In burning the less pure limestones, or those which contain a large proportion of alumina or sand, the management of the fire must be particularly atteuded to; for a heat of too great intensity produces a vitrified mass. Good lime is obtained at a low red heat; but if the fire be raised to a white heat, the mineral melts into a glass. The purity of common limestones, it has been already noticed, may be estimated by their loss of weight in burning; for the quantity of calcareous matter corresponds with the loss of weight. If the limestone is not apt to *run*, or become vitrified in burning—if the calcined stone or shells be extremely light, and require a great deal of water to slake them fully—if it swell much in slaking, and if the lime be light, fine to the touch, and of a pure white—it may be safely concluded that the lime is of a good quality. The magnesian limestones, when subjected to calcination, lose more than half their weight.

Soils requiring lime.—The soils which are essentially improved by the use of lime, are such as are denominated cold, stiff soils, as strong clays and deep loams, or such as are combined with a large proportion of vegetable matter, but contain no portion of calcareous earth in their composition. Lime may be regarded as of singular advantage in all soils and situations, excepting on thin loams, sandy soils, or those which are already replete with that earth. To ascertain whether any calcareous matter exist in a soil, recourse may be had to a very simple experiment, proposed by Mr Young. Let a small quantity of the soil to be examined be collected by going over the field, and taking up from different parts of it a few grains with the finger and thumb. The whole being put together, and introduced into a wine-glass, add first a little water, and after stirring it, and allowing any air that may adhere to the particles of earth to escape, pour on a little muriatic acid; if no effervescence take place, the soil may be accounted destitute of lime.

Application of lime.—Considerable diversity of opinion prevails with regard to the time and circumstances of the soil in which lime should be applied. In whatever way lime operates, whether by its mechanical effects on the soil, altering and improving its consistence and texture, or by certain chemical changes on the organized matter in the soil, or on its vegetable productions, by which they are rendered more healthy and vigorous, one of the first objects in its application is its equal and uniform distribution, that it may be brought into contact with every part of the soil on which it is to operate. But with all our improvements in rural economy, in many parts of the country, at the present day, no work is performed in a more slovenly and imperfect manner.

To insure this equal distribution, the lime must be in the form of powder, and in as dry a state as possible. For this purpose the calcined stones should be laid together in considerable heaps; and as they absorb moisture from the earth or atmosphere, they gradually swell and fall to pieces. But in case this process of spontaneous slaking, as it may be called, should not go on with sufficient rapidity, it may be promoted by throwing water on the heap. Too much water must be avoided; or, in case of heavy rains before the lime is spread out on the field, it has been very properly recommended to cover up the heaps to prevent it from running together into clots, or forming a kind of mortar. Might it not be suggested as a useful and convenient method, for the equal application of lime, to mix it carefully with a quantity of dry earth; and if earth of a different kind from the soil to be improved could be easily obtained, the increased value of the compost, in contributing to the fertility of the land, would undoubtedly be an ample compensation for the additional labour? But perhaps the smaller quantity of lime which might be necessary in consequence of its more equal distribution, might, in some measure, counterbalance the extraordinary expense.

When lime is to be applied to land in fallow, a dry season should be selected, when the surface is in proper condition for its reception; and as much inconvenience and some injury arise to men and horses when this work is performed in windy weather, which also renders it difficult to spread the lime equally, a day should be preferred when a moderate breeze prevails, which, in some degree, assists in its uniform distribution. All the operations of tillage, after the application of lime, should be conducted when the soil is perfectly dry; and, to prevent the horses' feet from being corroded, they should not come in contact with water till the lime is brushed off; but in case of accidents, from its acrid effects, to men or horses, washing the part affected with sour-milk or whey is an effectual remedy; and the longer the milk or whey is kept the better it answers the purpose. Vinegar or stale urine is recommended as a substitute.

As lime cannot produce its effects without being intimately mixed with the soil, the time and condition of the land when this object can be fully attained, require attentive consideration. But on this point great diversity of opinion prevails. The most general rule that can be given for the application of lime, is, that the soil which is to receive it should be as dry as it can be made, and in as complete a state of division as can be accomplished by the operations of tillage. The dry season of the year, it is obvious, is the most suitable for the strict observation of this rule; for then the soil is in the best condition, and the operations alluded to are best performed. The spring, summer, and autumn months, when the weather is favourable, are the most proper for this kind of work.

Another general rule to be observed in the use of lime, is, that it should be mixed with that part of the soil which is nearest to the surface. The most proper time for its application, then, seems to be at the conclusion of the operations for fallowing, when all that is necessary, after it is equally spread, is a slight harrowing, or, if ploughing be required, it should be performed with a very shallow furrow, that the lime may not be buried too deep. With the same view of retaining this manure near the surface, lime is advantageously applied to lands destined for turnips, wheat, and other crops, immediately before the insertion of the seed, so that a moderate harrowing is the only operation that remains to be performed. Repeated ploughings are recommended by some, for the purpose of mixing the lime laid on fallow intimately with the soil; but there is some risk of part of it being carried beyond the reach of vegetation; and the same effect seems to follow when lime is laid on grass lands which are to be broken up; for the lime is carried to the bottom of the furrow; and its beneficial effects, if they are ever so powerful, are not experienced till it be again turned up by the plough in the operations for succeeding crops.

When lime is to be employed as a top-dressing for pasture-lands, it should be applied early in the spring or autumn, rather than in summer or winter; because in a dry summer the grass is apt to be burnt up, and in winter the effects of the lime are supposed to be diminished by frost. The same rule is perhaps equally applicable to the use of lime on moorland pastures.

Application a second time injurious.—When the effects of lime have disappeared, it might at first sight be expected, that a repetition of the dose would be equally beneficial, in restoring the exhausted fertility of the soil, with the first application. But, from very general experience, it appears, that unmixed lime added a second time to the same soil, even after an interval of many years, is injurious to vegetation; and hence it seems to be an established rule, in all cases where the use of lime seems to be indicated, to apply it in smaller proportion, and always in the form of compost with dung. This practice is highly advantageous.

Quantity of lime.—No precise rules can be given for the quantity of this manure which should be applied to any particular soil; it seems indeed to be more regulated by accident, or by vague opinion, than by any fixed principle. It appears to be a pretty general notion, that light, sandy, or loamy soils, require a smaller proportion than stiff clays; but in no case is the determinate quantity accurately ascertained. From this unsettled practice, it may be expected that the quantity of lime used as manure is extremely variable, and perhaps often regulated by its abundance in the district, or the expense at which it can be procured. The quantity of lime employed in different parts of the kingdom, and on different soils, varies from one hundred to five and six hundred, and even to a thousand bushels, for the English statute acre. But from an hundred to an hundred and fifty bushels are stated to be the average quantity commonly employed throughout the kingdom. In the Peak of Derbyshire, from three hundred and sixty to one thousand bushels are applied to the heath and moorlands, by which they are converted into excellent pastures. But, as it has been justly observed by Dr Coventry, that an excessive quantity, or an over-dose of lime, does not appear to have been in any case injurious, yet it is not beneficial, and is therefore to be considered as a useless expenditure.

The beneficial effects of a small quantity of lime in the improvement of hilly or outfield land, are fully illustrated in the practice of the late Mr Dawson, one of the most intelligent and judicious farmers in the south of Scotland. A few years after 1754, Mr Dawson wished to lime some outfield land in fallow, previously to laying it down in pasture. A sufficient quantity of lime, which was supposed necessary for the whole, could not be obtained in proper time; but observing the effects of fine loam on the surface of similar soil, he was induced to try the effects of a small quantity on the surface of the fallow, instead of a larger quantity ploughed down. Twenty acres were well harrowed in the autumn; after which, about 56 Winchester bushels of unslaked lime were, after being slaked, carefully spread, and immediately well harrowed in; and in three or four days afterwards the land was again harrowed, to mix completely with the soil those pieces of the lime which were slowly reduced to powder. In this state the land remained during the winter. In the spring it was sown with oats, with white and red clover, and rye-grass seeds, and well harrowed, without ploughing. The crop of oats was abundant; the grass grew luxuriantly, and continued to be a fine pasture, until it was broken up some years afterwards for a corn crop.

A similar experiment made twelve years afterwards by the same agriculturist on another hilly farm, affords a farther illustration of this excellent practice. Many parts of the land were too steep and elevated for tillage, although the soil had a tolerable depth of earthy mould. The lands were greatly exhausted by cropping, and were full of couch grass. They were fallowed; received the same quantity of lime; were harrowed, and sown with oats and grass-seeds in the spring: As in the former case, the oats were a full crop, and the herbage plants were abundant. Some of these fields were more than thirty years in pasture, and were still clothed with white clover and other excellent grasses, without the appearance of bent or fog. But the comparative view which is given of this experiment, merits particular notice. More than three times the quantity of lime was laid upon adjoining fields of a similar soil; but, being more calculated for tillage, the lime was ploughed in. Oats and grass seeds were also sown on these fields, which, during the first year, were covered with a fine pasture; but afterwards the bent spread so rapidly, that, in the course of three years, it was more abundant than the finer grasses.

The following practical inferences, drawn from Mr Dawson's experience in the use of lime and dung, are highly important.

1. That animal dung, dropt upon coarse benty pastures, produces scarcely any improvement; and that when sheep or cattle are folded, as they are confined to a small space, their dung, after a few years, has no effect, whether the land be in pasture or tillage.

2. That when land of this description is well fallowed and dunged, but not limed, the produce of the grain crop, and of grass for two or three years, is improved, but afterwards the effects entirely disappear.

3. That when this land is limed, if the lime be kept on the surface, or well mixed with it, and then laid down to pasture, the finer grasses spring up and thrive, even in high and exposed situations, to the exclusion of coarse herbage, for many years. In one of the experiments mentioned above, the pasture had continued of a good quality for more than thirty years.

4. That when a large quantity of lime is applied to such land, and ploughed down deep, the same effects do not follow, either with regard to the permanency of good pasture, or the fertility of the soil under tillage. On the contrary, unless the surface be well mixed with lime, the coarse grasses in a few years cover the soil, and the land is not enriched for future tillage by pasturing with cattle.*

Magnesian lime.—This variety of lime has been long used in those parts of England where it is abundant; but it was found, from general experience, that when it was employed in the same quantity with common lime, it injured the crops for many years. The cause of this remarkable diversity in the effects of lime were not discovered till 1800, when Mr Tennant examined this species of limestone, and found that it contained magnesian earth, which, when employed in large quantities in its caustic state, is hurtful to vegetation. From this circumstance it has been called *hot lime*. The quantity employed with good effect is from 25 to 30 bushels for each acre; and when the land is rich, and contains a large proportion of vegetable matter, it may be employed in

* Farmers' Magazine, vol. xiii.

larger quantities. But when the magnesia is in its mild state, or in that of carbonate, it seems to be an useful ingredient in the constitution of soils. The soil of the Lizard Downs, in Cornwall, which bear a short and green grass, which is an excellent pasture for sheep, and, when under tillage, produces the best corn in the country, contains mild magnesian earth.

Effects and operation of lime.—The effects of lime in improving the texture of the soil, and in contributing to its fertility, are so well known as scarcely to require any elucidation. It has been stated, indeed, that the improvement of a stiff soil by the use of lime, is such, that the saving of labour is almost a full compensation for the expence. The effects of lime are observed, not only in increasing the quantity of the produce, but also in improving its quality. Those who are accustomed to deal in wheat, entertain the opinion, that the husk or skin is thinner when it grows on land which has been limed, that is, that it yields a larger proportion of flour, and of better quality. It seems also to be a well established fact, that no kind of pease succeeds well, even on the richest and best manured soils, without the use of lime. The pease vegetate, and for sometime grow vigorously, but before they begin to ripen they become blighted, usually die away entirely before the pod is formed, and but rarely produce a few half formed peas; but when lime has been applied to the soil, an abundant crop of full formed pease is obtained. The same fact has been noticed in the southern counties of Scotland, particularly in the Galawater district. It has been observed, that the soil, however richly manured, without lime, throws up a profusion of straw in the corn and pease crops, but the grain is extremely deficient. This is completely remedied by the use of lime. The luxuriance of the straw is checked, and the seed, whether grain or pulse, becomes full and plump. In the same district, observation has established another important fact. It appears that one-third, and, in some cases, only one-fifth of the quantity of lime employed in other parts of the country, produce as powerful effects as the larger proportion. But perhaps it is more equally spread, or otherwise more carefully managed, in consequence of the great expense attending a long land carriage.

But although the effects of lime be obvious and certain, its mode of operation is yet a secret. Numerous speculations have been indulged on this subject; but till chemistry and physiology shall have made farther advances in unfolding the changes which take place in the soil, and in developing some of the secrets of the vegetative process, we must consider the whole as doubtful conjecture.

In the following remarks by Sir Humphry Davy, an attempt is made to explain the operation of lime in fertilizing the soil: "When lime, whether freshly burnt or slaked, is mixed with any moist vegetable matter, there is a strong action between the lime and the vegetable matter, and they form a kind of compost together, of which a part is usually soluble in water. By this kind of operation, lime renders matter, which was before inert, nutritive; and as charcoal and oxygen abound in all vegetable matters, it becomes at the same time converted into carbonate of lime.

"Mild lime, powdered limestone, marls, and chalk, have no action of this kind upon vegetable matter; by their action they prevent the too rapid decomposition of substances already dissolved, but they have no tendency to form soluble matters. It is obvious, from these circumstances, that the operation of quick lime and marl, or chalk, depends upon principles altogether different. Quick lime, in being applied to land, tends to bring any hard vegetable matter that it contains into a state of more rapid decomposition and solution, so as to render it a proper food for plants. Chalk and marl, or carbonate of lime, will only improve the texture of the soil, or its relation to absorption; it acts merely as one of its earthy ingredients; quick lime, when it becomes mild, operates in the same manner as chalk, but, in the act of becoming mild, it prepares soluble out of insoluble matter. It is upon this circumstance that the operation of lime, in the preparation for wheat crops, depends, and its efficacy in fertilizing peats, and in bringing into a state of cultivation all soils abounding in hard roots, or dry fibres, or inert vegetable matter.*

Chalk.

Chalk is also a carbonate of lime, usually in a state of greater purity than common limestone. The proportion of clay, or siliceous earth, with which it is combined, is in general very small. Chalk, from the slight degree of coherence among its particles, is light, porous, and easily reduced to powder. These properties render it valuable as a manure in the southern counties of England, where it abounds. Its effects must be in a great measure similar to those of the other calcareous matters in the same state of combination. It answers well for deep soils, and thin poor clays; but when employed on light soils, the usual mode of application is in the form of compost with dung, either as fallow for wheat, or as a top-dressing on grass, from which the moss, rushes, and other coarse plants, where previous draining has been performed, are soon banished.

Mode of application.—Chalk is sometimes burned, and then it is in the state of quick lime; but when it is employed unburnt, it should be reduced to small pieces, an operation of no great difficulty when it is dug from the pit about the end of autumn, and immediately afterwards laid on the land. From its porous nature it readily absorbs moisture, which freezing in the winter, causes the mass to swell and fall to pieces. It has been stated, that chalk applied to the soil, in excessive proportion, may prove injurious; but the remark surely proceeds from inaccurate observation, for the effects of chalk are not more powerful than those of lime; and it has been mentioned, from good authority, that an overdose of the latter is not prejudicial.

Sea Shells.

Shells, or the covering of testaceous animals, are composed of carbonate of lime and a portion of ani-

* Agricultural Chemistry, p. 277.

mal matter, ingredients which must render them highly beneficial as a manure. Extensive beds of broken sea shells are found on the shores of the ocean, in different parts of the kingdom, and are valuable sources of excellent manure to all soils which require lime in its mild state. When shells are burnt, their effects are similar to quick lime. Oyster and mussel shells in their fresh state are frequently spread on land, and are found to produce very beneficial effects. Might it not be an improvement in their mode of application, to have them bruised or pounded, by which both the calcareous and animal ingredients in their composition would be sooner incorporated with the soil?

Marl.

Marl is of great use as a manure where limestone and fuel are scarce or high priced. According to its composition or consistence, it is distinguished by different names, as *clay-marl, stone-marl, slate-marl, shell-marl.*

Clay-marl has some resemblance to clay, of which it often contains a considerable proportion, and it readily absorbs water. Stone-marl derives its name from its hardness, and is less soluble in water than the preceding. Slate-marl is of a laminar structure, is of an intermediate consistence between the two former varieties, and is not of a very absorbent quality. Shell-marl is distinguished by the shells in different stages of disintegration with which it is intermixed, and the slighter cohesion of its parts. This kind of marl is found deposited in places which have been covered with water, and the shells appear to belong to fresh water animals.

The value of marl as a manure depends chiefly on the proportion of calcareous matter with which it is combined. This may be discovered by the process already described in the analysis of limestone, and it is of some importance to ascertain the proportion of its constituent parts, if it be any object to apply a determinate quantity of calcareous matter to the soil to be improved. Some shell-marl has been found to contain 84 per cent. of carbonate of lime, along with some vegetable remains, which renders it peculiarly valuable as a manure. Marl is highly beneficial to certain soils which have lime in their composition naturally, or to which it has been formerly applied, by improving their texture and increasing their thickness, with the addition of the clay and other earths which it contains. It is particularly recommended for grass lands on a thin gravelly soil, in elevated situations where wild or sheeps sorrel abounds. The use of marl in different parts of England is very extensive. In Norfolk and Suffolk the quantity applied to light sandy soil is from 50 to 70 cubical yards the acre; and in the Isle of Man, clay-marl, to the amount of 200 tons for each acre, is employed.

Gypsum.

The use of Gypsum as a manure was first proposed by a German clergyman about the year 1768; since that time it has been extensively, and it is said most advantageously employed in America; but the result of experiments made in this country scarcely warrants the high commendation which it has received. Gypsum is a compound of sulphuric acid and lime. It is better known by the name of plaster of Paris. In some accounts of the remarkable effects of this substance in fertilizing the soil and improving the crop in America, it is stated, that the lands on which this wonderful change is produced are situated at the distance of 80 or 90 miles from the sea; and it is supposed, on the ground of doubtful speculation, that the benefit derived from gypsum as a manure in this country, may be counteracted by the muriatic acid and soda, or common salt in sea air, preventing or retarding its decomposition, or entering into new combinations with its elements, unfavourable to vegetation.

Quantity.—The quantity of gypsum employed in this country is from six to eight bushels per acre; and it has been stated, that it might be beneficial to turnips in dry seasons, to the amount of two bushels only for the acre, when the crop is in drills.

2. *Clay.*

Clay is sometimes advantageously employed in improving the texture and consistence of the soil, and particularly a light kind of sandy soil, which seems to be deficient in that earth. The quantity must be regulated by the nature of the soil to which it is applied, and the time recommended for its application is in the summer and autumn months, or before the winter frosts set in, that it may be broken down and well incorporated with the soil.

Burnt Clay.

The use of burnt clay as a manure has been long known in this country. It was communicated by Lord Cathcart to the Scottish Agricultural Society which existed before the middle of the 18th century. It was employed in the form of compost, in the year 1786, by Mr Arbuthnot, near Peterhead, in Scotland; by Mr Parsons, near Sherborne, in England, in 1794; by Mr Buckley, near Loughborough, in 1796; and it has been lately brought forward in the south of Scotland as a new discovery from Ireland. In the year alluded to, Mr Parsons burnt 1600 loads at least in one week, and not less than 500 loads in a single heap. The expense did not exceed 1½d. per load, and it proved a powerful and permanent manure to a cold retentive clay soil.

Preparation.—The mode of preparing and using this manure is thus described by Lord Cathcart, in a letter dated 1756: "Another piece of improvement which I had from the Earl of Halifax, is that of burning clay. Wherever he meets with heaps of clay in his grounds that have been raised when there has been occasion to make ponds or things of that kind, or when he has occasion to take out clay or mud out of the bottom of ponds, lakes, or ditches, all this he burns in this manner. He takes a long stretch of green ground nearest to the heaps. This stripe of ground he pares. The turfs are set up to dry; which being gathered into heaps at a good distance one from another, serve for kindling of the clay and mud. The driest of the clay is first laid on the kindling, and when that is well in fire, men continue to add of the clay and mud, even wet as they are out of the ponds or ditches, to the kindled heaps.

till the quantity is burned. In September or October the ashes are led out, at the rate of forty tons to an acre of the poorest grass, and spread immediately, so as to have the winter rains wash them in. My Lord reckons the charge of managing one acre in this fashion costs him 15s. Last year, that acre that formerly was not worth half-a-crown, produced him at the rate of two loads and a-half of hay, which was worth 50s."

The method of burning clay recommended by Mr Parsons, is the following: In the month of March, trenches about 3 feet deep, and 2½ wide, with small ones 18 inches deep, and 14 wide, are formed in the ground to be improved. The turf or surface-soil is first taken off, and equally spread on the ground; but the clay dug out is laid in heaps by the sides of the trenches to dry. The burning commences in May; a few loads of the worst clay are employed as a circular floor or foundation, about a foot thick, to prevent the burning of the surface of the earth under the heap. Three or four large billets of wood are placed upright in the middle of the floor, and leaning against each other; and round these, and over the whole floor, small faggots and brushwood are intermixed, and raised to the height of about 6 feet. Construct a turf wall, at least 3 feet thick, around the heap of wood, and of the same height; three or four openings about 2 feet wide and 2 feet high, and at equal distances, are formed over the bottom of the kiln, by placing three or four sticks across the top of each; throw a quantity of dry turf on the top of the pile, and then kindle the fire with wisps of straw at all the openings, and when the whole pile is on fire shut up the vent holes with turf. Supply the heat with the necessary quantity of turf and clay, which is to be regulated by the smoke emitted. When it is abundant, an addition of clay is required, but when diminished, air must be admitted by forcing a sharp stake through the crown of the heap. When the heap is raised to a convenient height, and the fire has nearly reached the top, rake down the red-hot ashes, and cover them immediately with turf. Before the sod-wall is entirely consumed, it must be replaced by a new one, which confines the heap, and by often pulling it almost flat, prevents its burning too fast. A heap of 60 or 70 feet in circumference, produces 500 loads of ashes. The fire must be carefully watched at all times. Sometimes it burns so fast, that the labour of five or six men is required to supply it with clay. A dry season is the most suitable for this kind of work; but a wet season only retards it a little, for large fires, after two or three days burning, are not extinguished by rain; and the ashes are of a superior quality when the process of calcination is slow and gradual.

The method of burning clay, as it is practised by Mr Craig at Cally, in Galloway, is to form an oblong inclosure of 15 feet by 10, of green turf sods, and raised to the height of three or four feet. In the inside of the inclosure, air pipes, communicating with openings at each corner of the wall, are drawn diagonally, and formed of sods, placed on edge, and of such a width as can be easily covered with another sod. A fire is kindled with wood and dry turf in the speaces between the air-pipes and the outer wall. The whole kiln is then filled with dry turf, and when it is well kindled, the clay is thrown upon it in small quantities. The pipe on the weather side of the kiln only is kept open; the other three being closed up, unless it should be necessary, from a change of wind, to re-open one of them. As the kiln is filled with clay, the outer wall must be gradually raised, and kept at least 18 inches higher than the top of the clay, to protect the fire from the action of the wind. When any breach is made in the outer wall by burning, it must be immediately repaired. The wall may be raised to any convenient height for throwing on the clay, and the kiln may be increased to any size by forming a new wall on the outside. Some of the kilns constructed by Mr Craig, afforded more than 100 loads of ashes. The proper management of a kiln of this description, depends on the exclusion of the air by the outer walls, and the attention that is given to have the top always lightly but completely covered with clay. The masses of clay are of various sizes, some as large as a man's head; and it burns better by being dried for a day or two before it be thrown on the kiln.

Effects and quantity used.—In a comparative experiment, by Mr Craig, of raising turnips by means of stable-dung and clay-ashes, the crop in the ground manured with the ashes sprung earlier, was more vigorous, and the turnips were double the size. In another experiment by Mr Wallace, in the same district, a very abundant crop of turnips was also obtained. The quantity of ashes employed was from 30 to 50 single cart loads for the acre. Mr Parsons applied from 50 to 60 bushels to the acre, on a cold, wet, cohesive soil. Mr Buckley employs about 70 cart-loads to the acre of a stiff soil, on which he thinks its effects in improving the texture, and communicating permanent fertility, are more striking than in any other. The ashes of burnt clay have been also applied as a top-dressing to grass lands, and, according to Lord Cathcart's statement, at the rate of 40 tons to each acre, they produced very powerful effects.

3. *Coal Ashes, &c.*

Ashes, or the product of the combustion of different substances, are found to be useful as manures to certain soils, and chiefly coal and peat ashes.

Coal ashes.—Coal ashes, although rarely employed unmixed with other substances, afford an abundant source of manure in the neighbourhood of populous cities, where coal is the principal fuel. The ingredients of coal ashes vary in their nature and proportions, but they consist chiefly of aluminous and siliceous earth, with a portion of lime, and sometimes of magnesia. These ashes are found to be highly beneficial in correcting the tenacity, and opening the texture of clayey soils. They are in particular use in the neighbourhood of London, for improving those grounds from which brick earth has been dug out. After spreading the ashes on the clay bottom, horse-beans, or some varieties of the garden bean, are planted; and sometimes such lands are laid down with rye grass. Coal ashes answer well, when spread on clover, in March or April, on dry chalky soils; and the quantity employed is from 50 to 60 bushels to the acre.

Peat ashes.—The Berkshire, Wiltshire, and Newbury peat ashes, have been long celebrated in England as an efficient manure. They contain a considerable proportion of gypsum; and the other constituents are calcareous, aluminous, and siliceous earth, a small portion of common and Glauber salt, and sometimes a little oxide of iron, which is indicated by the red colour after calcination. Dutch ashes, the fertilising properties of which have been commended by Sir John Sinclair, in his Account of the Husbandry of the Netherlands, are composed of nearly the same ingredients. In the Netherlands, the Dutch ashes are applied as a manure to clover, which is succeeded by wheat. Nineteen bushels to the English acre afford an abundant crop of both. The English peat ashes are employed as a top-dressing for cultivated grasses, particularly sainfoin and clover, in the quantity of from 30 to 40 bushels to the acre.

4. *Sand, Loam, &c.*

Sand has been successfully employed in improving the texture of stiff clay soils. But sand taken up from the mouths of rivers or the shores of the ocean, as it frequently contains a portion of animal and sometimes vegetable matter, may also serve to promote their fertility. The sands of flat shores covered with water only during high spring tides, and which are strongly impregnated with common salt and other saline ingredients, are in some places collected and washed for the extraction of the salt, and afterwards spread on the land as manure. This double manufacture is pretty extensive on the northern shores of the Solway frith; and it seems probable that the latter practice might be advantageously adopted in many places where the situation is favourable. The rubbish of houses, or of old walls built with stone and lime, which is a mixture of sand and lime, with other earthy and sometimes saline matters, constitutes a valuable manure, and in all cases ought to be carefully collected and preserved. Loam, mould, or any mixture of different earths with a portion of organized substances, when added to a bare and sterile soil of a different quality, produces wonderful effects in throwing up a luxuriant race of vegetables.

Sect. II. *Of Putrescent Manures.*

The manures which come under this denomination are obtained from the decay and decomposition of various matters which are furnished by the vegetable and animal kingdoms. Manures of this description are sometimes entirely composed of vegetable matters; sometimes they are chiefly of an animal nature, and often they consist of both. Passing over minute distinctions, we shall consider them under the two heads of vegetable and animal substances.

1. *Vegetable Matters.*

Vegetable substances are applied to the soil for the purpose of contributing to its fertility, either in a fresh and green state, or when they have been subjected to complete decomposition.

Ploughing down green crops.—The practice of turning down crops of succulent green vegetables, as clover, buck-wheat, vetches, beans, turnips, that they may undergo the process of putrefaction on the the soil, and afford nourishment to the growing crop, has been recommended by some writers on agriculture, and is occasionally followed. When this method is to be adopted, a portion of lime, or of peat and lime, or rich vegetable earth, may be spread upon the crop; and after rolling, it may be buried with the plough. This work should be performed in the summer or early part of autumn, that the decay of the vegetable matters may be more speedily promoted. In cases where manure is scarce, this practice may be found useful. But it has been observed by Dr Coventry, that its advantages upon the whole are doubtful; for although it is probable that the quantity of vegetable matter is increased, the expence of the acquisition seems too great; so that facts are yet wanting to prove its economy.

River weeds, &c.—Weeds taken from rivers, ponds, and ditches, and other places, when collected in their most succulent state, and thrown together in heaps that the process of putrefaction may be promoted, afford excellent manure. The heaps should be formed by throwing the materials together as lightly as possible; and sprinkling them with water in a dry season is useful. A small quantity of lime or a portion of good vegetable or peat earth mixed with the heap, enlarges the quantity of manure, and increases its value. When these materials are in a dry state, the process of decomposition is slower; they must be kept moist, and liquid matters from the farm-yard would be found greatly to promote their dissolution. The mud taken from the bottom of rivers, containing a large proportion of vegetable matters, may be frequently employed as useful manures. A portion of lime or rotten dung may be added to the mass, which being frequently turned over, is reduced to a proper state of preparation as a top-dressing for grass lands. But the precaution of spreading manure of this kind thinly, or in small proportion at one application, should be strictly observed.

Malt dust, &c.—The dust of malt, along with the tails or coombs, which are the radicles of the seed protruded by vegetation during the malting process, when they can be got in large quantity, are a useful manure. They are greatly improved, and the quantity increased, by strewing them in the bottom of poultry and pigeon-houses, dung heaps, and necessaries, and also in the bottom of reservoirs into which the urine of cattle and soap-suds are discharged. Malt dust is sown by the hand, from 24 to 32 bushels to the acre, along with barley, and is harrowed in with the seed. It is suitable to most soils.

The husks or ashes which remain after the pressure of rape, cole, and other seeds, to obtain the oil, are also used as manures. They are either reduced to the state of coarse powder, sown by the hand, and harrowed in with the seed, or blended with the materials of the dunghill which has been collected from lean stock, with a great deal of litter. A ton of oil cake, mixed with 20 or 30 tons of dunghill compost, constitutes a rich manure. The proper time for the application of this manure is immediately before showery weather; for the process of decomposition seems to be retarded, till it has absorbed moisture. When in the state of coarse powder, from 30 to 40 bushels are applied to the acre.

Bark, saw-dust, &c.—Bark, after being employed in tanning leather, is used as a manure; and for this purpose it should be collected into heaps of a moderate size, while it retains some moisture; and then by mixing lime with it, and sprinkling with water, the decomposition is promoted. Bark should be reduced nearly to the state of vegetable mould when it is applied to grass lands. It is a prevailing opinion, that this manure is more suitable to stiff and heavy soils than those of a lighter description.

Saw-dust or shavings of wood, when applied to soil, without addition, are slow in their operation; but when they are mixed with animal matters, as blood and garbage, a more rapid decomposition is effected, and substances of this kind may be converted into useful manures.

Sea-weed.—Sea-weed of different species, as *fucus vesiculosus, digitatus, saccharinus,* and some others, is employed both for the purpose of making kelp and manure, on those parts of the sea-coast where it abounds. As a manure, it produces speedy and powerful effects; and those who neglect it, when it is within their reach, are little attentive to their own interest. Sometimes it is spread on the land as soon as it is cut from the rocks where it grows, or collected from the shores as it is washed in by the tides; and in this case it should be ploughed down immediately, for otherwise, in a dry season, its valuable properties are soon dissipated.

Another method of preparing sea-weed for manure is, to cut it in its most luxuriant and succulent state, and to collect it in large heaps, where it remains till it be completely rotten, and in a condition to be spread on the land. But, in this way, it is probable some saline matters are washed away by the rains, and its volatile parts are dissipated in the air. It would, therefore, be a more profitable plan of management, in the preparation of this active manure, especially when the plant is in its fresh state, to form a layer of fresh earth on the spot on which the heap is to be raised, and to mix the whole with a portion of quick-lime, and some other earthy matters; and perhaps it would be a useful precaution to cover the whole, to prevent the effects of the sun and air. By this last method of preparing sea-weed for manure, the quantity is not only increased, but its effects on the soil are more permanent. In the islands of Guernsey and Jersey, sea-weed is much employed as a manure. It is cut in the early part of the spring, and immediately applied to the barley and pasture lands.

2. *Animal Matters.*

The constitution of animal matters is more complicated than that of vegetables; and as the number of their elementary ingredients is greater, so their decomposition or putrefaction, when the vital principle ceases to act, proceeds with greater rapidity by the united agency of their component parts. The diversity of constitution, and of the proportions of the elements of animal matters, exhibit very different degrees in the progress of the putrefactive process, even when the circumstances of moisture, heat, and air are equally favourable. The decomposition of the liquid and soft parts is extremely rapid, while the more solid and harder parts remain for a long time unchanged. These remarks are worthy of attention, in considering the nature, properties, and changes of the animal matters which are employed as manures. The excrementitious matters of animals are in most common use for this purpose; and of these matters, the produce of the live-stock supported on the farm, as it is most abundant, is of greatest importance as a subject of rural economy. When mixed with straw, or other vegetable matter which has been used as litter, it is well known under the name of *farm-yard dung*; in the collection and preparation of which, it has been often asserted, and we fear with too much truth, that no branch of agriculture is so carelessly and slovenly conducted.

Farm-yard dung.—In the present mode of managing this kind of manure, little attention is paid to the situation of the dunghill, the means of promoting the decomposition of the animal and vegetable matters of which it is composed, or the preservation of those ingredients which are dissipated in the air, absorbed by the soil, or washed off by the rains.

Situation for a dunghill.—The proper situation for a dunghill is that where its bottom is nearly on a level, and is composed of such materials as are capable of retaining the moisture. For this purpose, it should be laid with clay, covered with broad flags, or common paving stones. The whole ought to be inclosed with a wall four or five feet high, and with an open space at one extremity, for removing the dung. At the opposite extremity, a reservoir is dug, which is either to be lined with clay, built round with stones, or fitted with a wooden cistern, into which a pump is introduced, for discharging the liquid as it accumulates. The reservoir must be placed at the lower part of the dunghill, and an opening is made in the wall opposite to it. Beside a main channel, which runs through the whole extent of the floor occupied by the dunghill, and terminates in the reservoir by the opening in the wall, a number of similar channels, of five or six inches deep, and of equal width, tending obliquely towards the main channel, is to be formed, well paved, and filled with brushwood, before the dung be laid down. Through these channels the redundant liquid is conveyed to the reservoir.

In laying out and constructing a dunghill, its longest side should run from east to west, should be surrounded by a wall, and covered with a thatched roof. To prevent the effects of the sun's rays, the wall on the south side is raised to the height of the roof; but, on the other three sides, it is sufficient to raise it five or six feet from the ground; and the roof may be supported with pillars of wood or stone. The upper part of the building may be employed as a poultry-house, a pigeon-house, or in some other useful way. By this construction, the dung is prevented from being scattered about, the action of the sun and air is obviated, and every soluble matter that escapes passes into the reservoir, from which it is drawn up by the pump, to be carried to the field, mixed with other substances, or returned to the dunghill itself.

Decomposition promoted.—In laying up the materials of which farm-yard dung is composed, with the view of promoting its speedy decomposition, it is of no small importance that they should be intimately mixed; and here, although it is attended with additional labour, the method of constructing hot-beds, in which the materials are carefully blended, and lightly laid together, may be advantageously imitated. By laying it up in this way, and moderate watering, it is well known that the dung of a hot-bed is as completely decomposed in three or four weeks, as that in a farm-yard, by the usual management, in four or five months. No animals, not even poultry, should be allowed to go upon it. The cart-load, as it is carried out, should be laid down by the side of the dunghill, and afterwards laid regularly and lightly upon it with a fork; and when it is laid up in this way, with a sufficient quantity of moisture, the decomposition proceeds rapidly. In dry weather it may be necessary to water it, or a sufficient degree of moisture might be kept up by means of the urine, which might be conveyed from the offices into reservoirs, from which it might be thrown upon the dung. By this management, the complete decomposition of the whole may be effected in six or seven weeks, and the produce will turn out to be one-half more valuable. But where greater attention can be paid to this important business, it has been suggested, that no greater quantity should be formed into one dunghill than what can be collected in the course of a month. At the end of the month it is to be turned over, thoroughly mixed, left to heat for another month, and again turned over, when it is fit for being applied to the soil.

But in the means employed to promote the decomposition of the mass of vegetable and animal matters, some attention is requisite to prevent the process from going on too rapidly, or advancing too far. Observation and experience may decide what is the most proper temperature; and, when this is once known, the whole preparation may be precisely regulated by the thermometer, a convenient form of which, for this and similar purposes, has been invented by Mrs Lovi, glass-blower in Edinburgh.

Quantity of manure increased.—Various methods have been proposed for increasing the quantity of manure. Two of these have been mentioned. The first is, by securing the liquid as it drains from the dunghill, and either spreading it on the soil or mixing it into compost; and the other is, by collecting the urine of the horses and cattle in a barrel or cistern, to which it is conducted by a proper channel. The quantity of manure may be greatly increased by collecting earth, moss, turf, the cleanings of ditches or drains, some of which are found on most possessions, and either laying them in the bottom of the dunghill, by which they are saturated with the moisture which soaks downwards, or by laying them in heaps by themselves, and pouring the liquid of the dunghill and the urine of the cattle upon them. In this way an excellent manure is prepared; and by this management the quantity, in almost every instance, may be doubled.

The quantity of farm-yard dung which is obtained from a given proportion of straw, when the business is properly managed, has been estimated at three to one, or three tons of manure for every ton of straw employed. The weight of straw produced on each acre, varies from a ton to a ton and a half; so that taking the different crops on an average, every acre of ground under a corn crop may afford a quantity of straw sufficient for the preparation of four tons of manure.

Night soil.—This matter forms a very rich manure, and, when applied unmixed, it ought to be used in small quantities; but it is recommended to mix it with saw-dust, peat-moss, or a portion of earthy matter, by which it may be more equally distributed. When a certain proportion of lime is added, it is soon deprived of its offensive smell, and rendered so dry that it can be easily applied as a top-dressing. Two cart-loads of night-soil, with ten loads of earth, and one of lime, are a sufficient quantity as a top-dressing for an acre. This compost forms an excellent manure to a light soil, destined for wheat or barley. It should be employed early in the spring for wheat, and it may be either harrowed in with the seed, or spread on the young barley crop. A compost of this kind is peculiarly adapted to drill crops.

Pigeons' dung, &c.—The excrementitious matter of birds, and particularly of pigeons, has been long accounted a valuable manure, and is found peculiarly beneficial for a cold, stiff soil. For the purpose of equal distribution, it should be broken down small, or mixed with earthy matters. The proper time for its application is during moist weather, and, as well as other manures, should be covered in by harrowing, when that work can be conveniently executed. The dung of poultry is somewhat of a similar nature, and may be employed in the same way.

Bones.—Bones are advantageously employed as a manure in many parts of England. Sometimes they are applied alone, and sometimes conjoined with other substances. Bones are composed chiefly of phosphate and carbonate of lime, and oily matters, so that they afford, by their decomposition, valuable ingredients for enriching the soil. The bones are used by being bruised, and broken down into small pieces, or reduced to powder. These operations are performed by mills, similar to those for reducing hard substances to powder. After this preparation, they are laid upon the field in small heaps, at regular distances, and covered with earth; having remained for some time in this state, they are spread on fallow, grass, or turnip land. This manure succeeds best on a deep clay, or loamy soil. Powdered bones are extremely convenient for drill crops, because they can be inserted at the same time with the seed.

Horn, &c.—This substance, containing a larger proportion of animal matter than of lime, is a still more powerful manure, and particularly in the form of shavings or turnings. The composition of hair, woollen rags, and feathers, is somewhat similar, so that these substances may be applied to the same useful purpose. The refuse of manufactures of skin, leather, and glue, as furriers clippings, curriers shavings, &c. is also valuable manure.

Putrid animal matters.—Dead animals being covered up with five or six times their bulk of soil, mixed with one part of lime, after a few months become an excellent manure. The offensive smell may be obviated by adding a little fresh quick-lime when they are removed. The refuse of shambles may be treated in the same way. An active manure is obtained from different kinds of fish, as herrings and pilchards, but it must be employed in small quantities, or mixed with sand or soil, otherwise the crop may be too luxuriant; and in some cases, where such matters were applied in excessive quantity, it has been entirely lost. Greaves, or the refuse of the candle-manufacturer, and blubber, are valuable substances, when mixed up with earthy matters, for enriching the soil.

Sect. III. *Of Saline Manures.*

Various saline substances are employed for the purpose of manure, but they are chiefly in a state of combination with other matters, as the refuse of different manufactories. The refuse of bleachers contains a portion of alkaline matter; and, from the active nature of this ingredient, it is necessary that it should be well mixed with eight or ten parts of fresh mould, or peaty earth, and with a certain proportion of rotten dung. From a compost of this kind a valuable manure is obtained. Soapers waste, beside the alkaline matters in its composition, contains a considerable quantity of lime, and may be treated in the same way. A manure of this description is of great use on stiff, clayey, and loamy soils. The ashes of fresh vegetable substances contain also some alkaline matter; and being mixed with vegetable mould, or peaty earth, in large proportion, they afford a rich manure, and are very effectual as a top-dressing to grass-lands. Soapers waste spread on mossy or peaty soils, has proved one of the most active and speediest applications for promoting their decomposition, and converting them to vegetable mould.

Soot.—Soot, in consequence of the carbonaceous and oily matters, and the ammonia, or volatile alkali, which it contains, is also a very active manure. The quantity employed for the acre is from 20 to 40 bushels; but in the neighbourhood of London, where it is extensively used, 30 bushels are considered as a complete dressing; but if dung, or any other manure, have been applied to the same crop, the quantity of soot is reduced to a half, or about 15 bushels. Soot is said to answer best for wheat when applied in the month of April, or on pease or clover at the same time, or when sown with barley and harrowed in. It is recommended as a useful application, at any period in the spring, for the destruction of grubs or worms, and when thinly distributed on newly sown turnips, just before they come up, prevents the injury which they sustain from the fly. The soils to which this manure is most suitable are those of a light, dry, and chalky nature, and the best time for inserting it is during showery weather.

Common salt.—The use of common, or sea salt, has been strongly recommended by some as a powerful manure, while others, keeping in view its antiseptic property, consider its effects to be of a doubtful nature. The high price of salt in this country must be a serious objection to its extensive use; but it is generally employed in combination with other matters, as the refuse of the salt manufactory in Cheshire, or of the processes of the curing of pilchards in Cornwall, or of herrings in other places. The animal matters, in the latter instances, may be supposed to contribute their effects; but those who have had experience of these substances as a manure, always select such as contain the largest proportion of salt. A portion of sea-salt adhering to sand collected from flat shores, or mud in the vicinity of rivers and salt marshes, has been often found highly beneficial in enriching the soil, and improving its productions. In Cornwall, abundant crops of turnips have been produced by the use of salt; but some doubts are entertained, whether part of the effect ought not to be ascribed to the destruction of the slugs, which was the consequence of its application. In some cases, where salt was employed in large quantities, its effects were injurious, but in a smaller proportion they appeared to be highly beneficial.

Sect. IV. *Of Compost Manures.*

Two or more of the various earthy, vegetable, animal, and saline substances which have been mentioned, being blended together in different proportions, form compounds which are extremely valuable as manures. In this way, not only the quantity of the manure is greatly increased, but its quality is much improved. Some of the ingredients which, when employed singly, would be almost useless, after being mixed with other matters, and subjected to certain changes, form a most excellent application for improving and enriching many soils.

All manures may perhaps be considered as compounds, at least after they are applied to the soil; and it might be a question, whether the benefits which they afford to vegetation could not be increased, if some of the changes which they undergo were previously completed, or whether these benefits arise at the time when the new combinations are effected? but this question, which is of great importance, and of no small difficulty, must depend for its solution on a more perfect knowledge of the process of vegetation itself, as well as those changes and combinations which are effected by the mutual action of the different matters employed as manures.

Some of the methods of forming composts, and of increasing the quantity of manure, have been already described; and, in general, it may be remarked, that they are formed of almost every kind of vegetable and animal matter, mixed with earthy and saline substances, which being thrown together in considerable masses, promote the decomposition of the organised materials; and it is scarcely necessary to add, that the collection and preparation of such compound manures must be regulated by the nature and abundance of the matters which can be obtained.

In making a compost with one kind of manure, and a portion of soil, the two substances are placed in alternate layers, in the form of a long ridge; and it should be so covered at the top, that the rain may be prevented from washing through it; but if both lime and dung are used, a layer of earth should be interposed between every two beds of lime and dung, that the excessive action of the lime may be obviated. When the decomposition of the dung is completed, the whole should be turned, that the ingredients may be well mixed, and the same operation is to be repeated till the mass is sufficiently reduced.

The quantity of this compost may be increased, by collecting all the weeds before they run to seed from the neighbouring fields, and adding them to the heap, and the weeds which grow upon it should be buried down in it before they flower and produce seeds.

A compost is also formed, by ploughing and harrowing a head land till the soil is well divided. Forty bushels of lime, fresh from the kiln, are arranged in an equal number of heaps, along the middle of the head land, at the distance of four feet from each other. The heaps are covered with four or five times their quantity of pulverized earth, which is clapped close down with the shovel, to prevent the access of rain or air. The lime is slaked in a few days by the moisture of the earth, and when any cracks or fissures appear, by the swelling of the heap, they are to be covered up with more earth. When the lime is reduced to powder, it is intimately mixed with the earth. This is done in the form of a long bank or ridge, in the middle of which a large furrow is left, capable of receiving five cart-loads, of forty bushels each, of farm-yard dung. The mixture of earth and lime is thrown over the dung, that the whole may be entirely covered. In this state it remains for some months, when it is to be turned over, well mixed, and formed into a heap.

Sweepings of streets and roads.—The fertility of the lands in the neighbourhood of great towns, is kept up by the manure which is collected from the streets and houses. The high price which is paid for this manure, is an ample proof of its value. Made up of almost every kind of vegetable and animal substance, it is perhaps the most compound manure that is employed.

The value of the sweepings of roads depends partly on the ingredients of which the road is formed, and partly on the quantity of excrementitious matter which is dropped by animals; and as the latter is most abundant in the neighbourhood of large towns, the best manure of this description is collected in such situations. When the stones of which the road is constructed are of basalt, or whin-stone or lime-stone, the decomposition of these earthy matters forms of itself a good manure; but its value is greatly increased in the form of compost with vegetable and animal matters, with which it is usually combined. By collecting these matters, the advantages, in preserving and improving the roads, would not be less considerable than in enriching the lands in their neighbourhood.

Compost of peat-moss.—As peat-moss consists chiefly of vegetable matter, when its entire decomposition is effected it constitutes a very valuable manure. Considering it in this view, Lord Meadowbank has particularly described the methods of its preparation, of which the following is an abstract. The compost of which the peat-moss is to be formed, should be dug out for some weeks or months, that the redundant moisture may evaporate, which, by rendering it lighter, diminishes the expence of carriage, and requires a smaller proportion of dung. The peat-moss is then carried to a dry spot, convenient for constructing a dunghill to serve the field to be manured. It is laid out in two rows, with an intermediate row of dung, which occupies the space of the compost dunghill; and the rows should be so near, that the workman may be able to throw them together with the spade. A layer of peat, 6 inches deep and 15 feet wide, if the breadth of the ridge admit of it, is first formed. A layer of 10 inches of dung next succeeds, then 6 inches of peat, then 4 or 5 of dung, and then 6 more of peat; then another thin layer of dung; then cover it with peats at the end where it was begun, at the two sides, and above. The height should not exceed 4 or 4½ feet, otherwise the weight may be too great, and check the decomposition. The workmen continue adding to the compost as they are furnished with the three rows of materials; they must be careful not to tread on the mass, which would render it too compact. When the peaty earth is wet, it should be made up in lumps, and less broken.

Proportion of ingredients.—When the weather is mild, 7 cart-loads of common farm-yard dung, in a fresh state, are sufficient for 21 cart-loads of peat-moss; but in cold weather a larger proportion of dung is required, because more heat is necessary. To every 28 cart-loads of the compost, it is useful to throw above it a cart-load of coal, peat, or wood-ashes; but when such ashes cannot be procured, half the quantity of slaked lime, in fine powder, is a good substitute. The dung employed should be fresh, or kept in a fresh state by compression, as by the treading of cattle, or of carts passing over it. If the quantity of litter be small, a smaller proportion of dung answers the purpose, provided any addition of vegetable matter can be made, as fresh weeds, rubbish of a stack-yard, stems and leaves of potatoes, the sawings of timber, &c. A greater or less quantity of compost is obtained by the state of the dung, as it is more or less advanced in the process of decomposition. By employing the refuse of shambles, six times the quantity of moss may be converted into manure. A similar proportion is obtained from the dung of pigeons, and of domestic fowls; and to a certain extent, from the dung collected in towns, and made by animals that feed on grains, the refuse of distilleries, &c.

Progress of decomposition.—When the compost is made up, the temperature increases according to the state of the weather and the condition of the ingredients. The heat comes on in summer in about ten days, but in the severe cold of winter it requires as many weeks. In summer sometimes the temperature rises so high as to consume the materials, when what is called *fire-fanging* takes place. When such a change is apprehended, a stick should be kept in different parts of the mass, which being occasionally examined, indicates the increase or diminution of temperature; or what answers better, is the thermometer, constructed by Mrs Lovi of Edinburgh, which we have already recommended, and with the aid of which the changes of temperature can be precisely ascertained. If the temperature approach to or exceed blood-heat, the mass should be watered, or turned over, and at the same time an addition of fresh moss may be made. In the progress of decomposition, the heat, according to various circumstances, at last subsides; the mass remains untouched till within three weeks of the time of applying it to the land, when it should be completely turned over, and all the lumps broken down. It heats a second time, but soon after cools, after which it is fit for use. Excepting the pieces of decayed wood, the whole appears a black free mass, which spreads like garden mould. When this compost is employed weight for weight as farm-yard dung, it has been found, in a course of cropping, fully to stand the comparison.

When a compost is made up before January, if the frost be not severe, or long continued, it is ready for the spring crops; in summer the preparation is completed in eight or ten weeks, and the decomposition is greatly promoted by adding lime, rubbish of old buildings, or lime slaked with foul water.

Quantity applied.—The richness and condition of the soil, and the season in which the manure is applied, have varied the quantity of this compost; but from 23 to 35 double cart-loads include the extremes of the proportion which has been used for the acre. The smaller proportion has been given to fallows and ground in good condition, and the larger proportion when it is ploughed in with the sward of poor soil. The intermediate quantities were used with crops of tares, pease, and potatoes.

It is properly stated by Lord Meadowbank, that too much attention cannot be given to the preparation of the ground to which this compost manure is to be applied. It should be clean, dry, well mixed, and friable; for, in any other state, it requires a larger proportion of manure. The addition of a small quantity of well prepared compost, has produced a wonderful effect on land well prepared by a fallow. The texture, colour, and other qualities of the soil, undergo a very preceptible change. All this, it is added, must proceed from the mutual action of the different ingredients in the manure and in the soil, and the various decompositions and combinations which are the result of that action; and it is quite obvious, that all this must be greatly promoted by bringing the minute particles in the soil and manure into contact by intimate mixture.

Compost of peat, lime, and clay.—In the year 1786, Mr Arbuthnot, mentioned above, collected 1000 cart-loads of peat-moss (about 300 tons,) of which was formed an oblong square, 70 or 80 feet long, from 14 to 18 feet broad, and 6 feet high. To this were added 30 bolls lime-shells from Sunderland. The shells were introduced by cutting trenches across the bed of moss, and covering up one trench with the moss which was thrown out of the other. When the whole lime was covered up, a considerable quantity of water was added, and in two or three days the mass took fire. About 150 tons of wet clay, in lumps, were then thrown on at random. At the end of four or five days, the bed was covered up with clay sods, and it remained untouched for eleven months; at the end of which time, when it was carried to the field, the heat was so great that it could scarcely be handled. The compost thus prepared was laid on $7\frac{1}{2}$ acres of grass land, sown with clover and rye-grass three years before. The grass was greatly improved, and the land was not broken up for six years afterwards. The field was several times in corn and grass; and the grass was always cut and never pastured, without receiving any manure till 1810.

In concluding the history and application of different manures, we shall give a short view of some curious experiments conducted by the Reverend Mr Cartwright, which shew the effects of different manures on the same soil, and for the same crop. One object of these experiments was, to ascertain the effects of salt in promoting vegetation. The soil was a ferruginous sand, which was brought to a proper texture and consistence by a liberal covering of pond mud. Four hundred grains of this soil contained 280 of siliceous sand, 104 grains of finely divided matter, and 16 of loss in water; of the 104 grains, 18 were carbonate of lime, 7 grains of oxide of iron, 17 grains lost by burning, and the remainder silica and alumina.

On the 14th of April 1804, a portion of this soil was laid out in beds, a yard wide, and 40 yards long. Of these, 25 were manured, the first excepted, as follows.

No.		No.	
1.	No manure.	13.	Salt, lime, sulphuric acid.
2.	Salt, $\frac{1}{4}$ peck.	14.	Salt, lime, peat.
3.	Lime, 1 bushel.	15.	Salt, lime, dung.
4.	Soot, 1 peck.	16.	Salt, lime, gypsum, peat.
5.	Wood ashes, 2 pecks.	17.	Salt, soot.
6.	Sawdust, 3 bushels.	18.	Salt, wood ashes.
7.	Malt dust, 2 pecks.	19.	Salt, saw-dust.
8.	Peat, 3 bushels.	20.	Salt, malt dust.
9.	Decayed leaves, 3 bushels.	21.	Salt, peat.
10.	Fresh dung, 3 bushels.	22.	Salt, peat, bone dust.
11.	Chandlers greaves, 9 lbs.	23.	Salt, decayed leaves.
		24.	Salt, peat ashes.
12.	Salt, lime.	25.	Salt, chandlers greaves.

The quantity of each ingredient was the same as when they were used singly. On the same day a single row of potatoes was planted in each bed; and that the experiments might be accurately conducted, the number of sets was the same. A few days after, the plants appeared above ground; on the 14th of May they were carefully examined, and the comparative excellence of each row, according to appearances, was noted. The best row was No. 7. from malt dust; the next was from chandler's greaves; bnt we shall not detail the farther results of this examination. On the 28th of May, 14 days afterwards, the rows of plants from malt dust and chandler's greaves still retained their superiority. The most backward row at this time was that manured with saw-dust.

On the 21st of September the potatoes were taken up, when the produce of each row was as follows:

No. 17.	Salt and soot, produced	240
11.	Chandlers greaves	220
18.	Salt, wood ashes	217
16.	Salt, gypsum, peat, lime	195
15.	Salt, lime, dung	199
2.	Salt	198
25.	Salt, greaves	291
4.	Soot	192
10.	Fresh dung	192
20.	Salt, malt dust	189
5.	Wood ashes	187
23.	Salt, decayed leaves	187

Manures.

24. Salt, peat ashes	185
7. Malt dust	184
14. Salt, lime, peat	183
19. Salt, saw-dust	180
22. Salt, peat, bone dust	178
9. Decayed leaves	175
13. Salt, lime, sulphuric acid	175
21. Salt, peat	171
8. Peat	159
12. Salt, lime	167
1. No manure	157
6. Saw-dust	155
2. Lime	150

It is observed by the author of these experiments, as a remarkable circumstance, that of 10 different manures, most of which are of acknowledged efficacy, salt, whose effects were doubtful, is, with one exception, superior to them all; and, in combination with other substances, no other manure besides chandlers greaves was injured by it. The effects of salt combined with soot were very striking; and Mr Cartwright is disposed to ascribe these effects rather to the power of attracting moisture from the atmosphere, than to any chemical action between the two substances; for the beds on which salt was used continued visibly moister, even for weeks after its application. Another circumstance noticed is, that the plants which grew on the beds manured with the salt were of a paler green than the rest, but equally luxuriant, which appearance, he at first concluded, indicated a want of vigour; and wherever salt was applied, either by itself, or in combination, the roots were perfectly clean, which was not the case with those in the other beds.

The same ingenious agriculturist instituted two sets of experiments with turnips and buck-wheat, on a soil so poor that it produced only dwarf heath and lichen. Of 400 grains, 320 consisted of siliceous sand, 68 of finely divided matter, and 12 of loss in water. The finely divided matter lost nearly half its weight by incineration, and the remainder was composed chiefly of aluminous and siliceous earths, coloured with oxide of iron. Scarcely any calcareous matter appeared. On the 6th July 1804, the beds selected for each set of experiments were respectively sown with turnips and buck-wheat. They were numbered and manured exactly in the same way as in the first set of experiments with potatoes. On the 20th July, numbers 1, 2, 4, 5, 6, 7, 19, 20, 21, 22, 24, 25, shewed little or no marks of vegetation; the remainder were merely in the seed leaf. On the 16th of August four only were alive, and in rough leaf, viz.

No. 12. Salt and lime.
13. Salt, lime, and sulphuric acid.
14. Salt, lime, peat.
16. Salt, lime, gypsum, peat.

These four continued in a sickly state till the middle of September, soon after which they disappeared. The appearance of the turnips and buck-wheat was very nearly the same; but no certain conclusion can be drawn from these experiments with regard to the effects of salt as a manure for such crops, for other manures of undoubted efficacy also failed. The inference to be deduced from the whole, is, that a proper texture and consistence of the soil is an essential requisite in promoting the health and vigour of plants, which was abundantly obvious in the greater luxuriance of those plants where the manure tended to improve that texture and consistence.

These experiments may serve as a model to those who have the inclination or leisure to investigate the effects of different kinds of manure on the crops to which they are applied; and although many of the experiments were made on substances which are procured with difficulty, or are to be had only in small quantity, and therefore cannot come into general use, yet the results obtained are curious and interesting, and, if farther examined, may lead to some valuable practical application.

Implements.

Chap. V. Of the Implements of Agriculture.

The almost endless variety of implements which have been invented and proposed for the purpose of abridging agricultural labour, or of performing it with greater accuracy and neatness, could not even be enumerated within a moderate space; but such enumeration would be an idle waste of time. Many instruments of this description have been laid aside as soon as they were tried; and the existence of others has been only prolonged by the fond partiality of their inventors, the desire of novelty, or the power of fashion. It seems no arduous task to form an opinion of the real utility of such implements. A machine of a cumbersome form, of a complicated construction, or of difficult management, may be at once pronounced unfit for the purposes of husbandry. For simplicity of construction and facility of application may be regarded as their essential character, and indeed of all others from which any practical advantage is to be expected.

Sect. I. *Of the Plough.*

The plough is an instrument for turning up the soil, by the power of horses, or other animals, and it is contrived to save the time and labour of man in preparing the ground and fitting it for the reception of the seed. The plough may be considered as a most important and valuable substitute for the spade. Diversity of soil, and of local circumstances, may produce variations in the manner of using the plough, but still there is a similarity in the operation, which gives a certain uniformity to the chief parts of the instrument, from which the principles of its construction are to be deduced. The seeming coarseness of the operation, or the clumsiness of the task of turning up the soil, has probably been the cause of the inattention and neglect which this implement long experienced. It has been considered as a rude instrument, because it could not be supposed that there was any nicety in a business which is succesfully performed even by the most ignorant. The importance of the machine is admitted by others; but from the complicated nature of the operation, and the uncertainty of the resistances to be overcome, or the little knowledge which we possess of estimating the kind and quantity of these resistances, the difficulty of constructing a plough upon undoubted principles is regarded as insurmountable, and its improvement

Implements.

is consigned either to experience or accident. This difficulty, it is acknowledged, is great; but it is not beyond the reach of mechanical ingenuity to overcome it. The preparation which the ground requires for the reception of the seed, and for the support and nourishment of plants, is pretty distinctly known; and though no instrument of the plough kind, can, by its operation, bring it into this state, yet none is ignorant that some ploughs greatly excel others in performing this task. The imperfections of their performance, or what defects remain to be supplied, are sufficiently understood; and as the operation depends on mechanical laws, the solution of the problem is brought within certain limits.

Action of the plough.—A distinct description of the operation of the plough, will serve to indicate what the general form and construction of this implement ought to be, the material parts of which must be found under every variety to which particular circumstances can give rise. The operation of the plough is not conducted by digging, but by being pulled along. The reduction of the soil to that friability and uniformity of which it is susceptible by means of the spade, is not aimed at; but it is brought into such a state that the ordinary influence of the season may finish the task. A slice or sod is cut from the firm land, which is pushed to one side, that the plough and the ploughman may proceed in their labour; the sod is turned over, that the grass and stubble may be buried and rot, and a fresh soil may be left on the surface, which should be so loose and open that it may become friable from the effects of the weather, without running to lumps, or retaining water. The first action is performed by the *coulter*, which makes a perpendicular cut; the point of the *sock* follows, and its edge passing under the sod lifts it up, and at the same time heels it over away from the firm land. The mould-board advancing, pushes it aside, and gradually turns it over as far as may be required.

Form of the plough.—The general form of the body of a plough is that of a wedge or blunt chissel. To render this form intelligible, it is necessary to describe the different parts of which the plough is composed. In Fig. 1. Plate 3. AB is called the beam; CD the stilts or handles, one of which is fixed in the beam; EF is the coulter, which is firmly fixed by its shank E. into the beam; GI is the sheath, the front of which is sharp, forming the edge of the wedge; HK is the mould-board; HL the base or sole, which is pointed at H, to receive a hollow shoeing of iron called the sock, and tapers towards L, which is called the heel. This piece is called the *head* of the plough. The back of the plough is usually called by ploughmen the *land side*, and the side formed by the mould board, is called the *furrow* side. The wedge-like form of the plough may be still more distinctly understood from Fig. 2. in which a plan of the same plough is given. AB is the beam; CD the stilts; EFI the mould-board; GH the sock. This form being attentively considered, it will appear that if the wedge be drawn or pushed along, keeping the edge in the perpendicular cut which has been previously made by the coulter, the point will raise the earth, turn it to one side, and throw it over; but as the wedge raises the earth, the earth presses down the wedge, and, as the wedge pushes the earth to the right hand, the earth presses the wedge to the left. In this way the plough is strongly pressed, not only to the bottom of the furrow by its sole, but also to the solid land by its back or land side. It is pressed into an angle formed by the perpendicular and the horizontal plane of the implement; and hence the furrow becomes a firm groove, directing the motion of the plough, and giving it such a resistance as shall enable it to perform all parts of the operation. This circumstance should be kept in mind, because it suggests a fundamental maxim in the construction of the plough, which is to make the land side an exact plane, and the sole, if not plain, at least straight from the bottom to the heel.

Implements.

Breadth of the sole.—The width of the furrow is determined by the breadth of the sole at the heel, and nine inches afford sufficient room for a horse and man to walk in. A greater breadth is of no advantage, so that force is lost in pushing the earth aside. A broad sole, as has been supposed, does not give more room for the turned slice to stand on; for whatever may be the breadth of the furrow, the successive slices are left at their former distances, because each is pushed aside at the same distance. When the breadth of a slice is greater than its depth, and is turned on its side, it stands on a narrow base, but higher and looser, which is desired by the farmer. When this happens, it generally falls on its back before it has been far enough removed, and is then turned aside, and left with its sward downwards, which is wished to be avoided; but, on the other hand, when the depth considerably exceeds the breadth, the sods, being turned on their sides, are squeezed home to the ploughed land, which breaks and tosses them up, producing coarse work; and if the soil be a wet clay, it is apt to be kneaded together. It appears, then, upon the whole, to be the best rule to have the breadth and depth nearly equal. The sole is generally level from right to left at the heel; and, from this construction, a furrow with a flat or level bottom is formed. With the same view, the land side of the plough should be held perpendicular, instead of heeling it over to that side, as is sometimes done, by which a ribbed furrow, or an irregular formed sole is produced.

Length of the plough.—Various opinions have been entertained with regard to the length of the plough. Considering it as a pointed or cutting instrument, acting obliquely on a given length of sod, its length being increased, adds to its power, for it requires less force to draw it through the ground; but as the earth must be turned aside at the same time, if the length be doubled, it must act on a double quantity of earth at once. It is found that the force required for pushing a mass of earth horizontally along the rough ground, is nearly equal to its weight. Nothing, therefore, seems to be gained by lengthening the hose of the plough, except a greater facility in the first penetration, which is chiefly performed by the coulter and sock; and, besides, a greater length renders the plough cumbersome and heavy. A long plough, which has a more extensive support, both on the land side and below, is less affected by ine-

Implements.

qualities, and has therefore a great advantage in the steadiness of its motion. It is now usual to make them considerably longer than formerly; and, according to the most approved construction, it has been assumed as a just proportion to have the length 33 inches by 9 inches in breadth.

Some advantage is derived from making the plough taper forward, where it acts as a boring and cutting instrument. For this purpose it is convenient to give the coulter a slope of 45°, by which the stones and roots, which it would otherwise push before it through the firm ground, are thrown up. For a similar reason, the edge of the feather, which is an appendage to the sock, having a cutting edge on the furrow side, extending back about ten inches, and to the right hand of the furrow side about six, for the purpose of cutting the sod below, and detaching it from the ground, as the coulter separates it from the unploughed land, has a great slope. But this advantage cannot be pushed too far, without other risks; for as it is sometimes necessary to incline the plough to the right, to get over some obstruction, the coulter must be raised, and a slanting cut made by the feather becomes the directing groove for the plough. When the slope of the feather is very long, this groove has force enough to guide the whole plough; and it is scarcely possible for the ploughman to prevent it from running out of the ground, to the land side. The length of the feather, then, should not exceed 10 or 12 inches.

Construction of the mould-board.—As the chief resistances are exerted on this part of the plough, and must be overcome, it requires the nicest consideration what is the best form for diminishing these resistances, while the operation is well performed. The task required is, to raise, push aside, and turn over, to a certain degree, a slice, which is already cut off from the solid ground. As every inequality of the cohesion or tenacity of the earth cannot be estimated, it may be considered as uniform, which is always the case with its weight; and as every proportion between the tenacity and the weight cannot be provided for, an average, or medium proportion, which is not far from that of equality, may be taken. If, then, the slice be conceived at first as only tenacious, and without weight, it is not difficult to determine the form which gives it the intended twist and removal with the least force. In the same way, the weight of a slice, without tenacity, may be determined. Both may be easily combined in any proportion; and the composition on the supposition of equality of weight and cohesion, is easiest made. If the slice be supposed to be in the form of a brick, the greatest force is required to begin to raise it on one edge, and the force diminishes as it rises, till the centre of gravity is perpendicular to the supporting angle. No force is required to raise it farther, for, in pushing it in the smallest degree beyond this position, it falls over of itself, unless retained by the tenacity of what is not yet raised. But observing the form or plan of the sock, it will be found, that when the weight of the sod has the strongest resistance, there is less of it in this situation actually rising, and this nearly in the same proportion with the trouble of raising it. After the sod has attained that position in which it is ready to fall over, it has reached the wider part of the rest, and is now pushed aside, which requires nearly the same force as to raise it. All these circumstances being considered, it seems probable, that the compound resistance changes little from first to last, and, if this be the case, it may be adopted as a maxim, should proceed equally. If it does not, there must be some part of the sod that makes a resistance greater than the medium; and, as the resistances in this kind of motion increase nearly as the squares of the velocities by which they are overcome, it may be demonstrated, that power is lost by rendering them unequal. Hence is deduced the maxim, that as the plough moves through equal spaces, the twist and lateral sliding of the sod should increase by equal degrees. This is the principle according to which Mr Small constructed his ploughs, which have deservedly attained so much celebrity. But, for the particular rules of constructing the mould-board, we must refer to Mr Small's treatise on the subject.

Bridle of the plough.—The bridle or muzzle of the plough is a curved piece of iron, which is fixed to the end of the beam, by means of a bolt, and to this bridle the swingle-tree, or cross-tree, is attached by a hook. Sometimes the bridle is fixed to the beam by two bolts, and has notches, by which the hook of the cross-tree may be placed either to the right or to the left of the beam; and there are different holes for the hinder bolt, by which means the line of draught is directed, either above or below the beam. In this way, by shifting the hook of the cross-tree to the right or to the left, a broader or a narrower furrow is taken, and by shifting the bolt, the bridle or muzzle is raised above or sunk below the beam, and the plough goes deeper or shallower, as shall be required.

Trim of the plough.—The plough is said to be in *trim*, and to *swim* fair, when it goes on steadily, without any effort of the ploughman; for then the pressure before and behind the centre of action is balanced. To know whether the plough be under this management, the draught-rope is to be hooked as high as possible, and in this state the plough should have a continual tendency to rise at the heel, and to run into the ground. When the rope is hooked as low as possible, the plough should press hard on the furrow with the heel, and have a tendency to run out of the ground. If both these circumstances are observed, the construction of the plough is, in this point, correct; if otherwise, the position of the sock, or of the beam, requires alteration. The tendency of the plough to go deeper, is corrected by lowering the end of the beam, or raising the point of the sock; and as the point of the sock should not be removed from the plane of the sod, the alteration by the beam should be preferred. The slope of the coulter has also a considerable effect, but it cannot deviate far from an angle of 45° without danger of choaking the plough with roots and stones driven before it. If the coulter of the plough be out of the direction of the plough's motion, it must tend to twist it into its own track, and as it must be fixed in the middle of the beam's thickness, to give it strength, it is removed a little from the plane of the land side; and to compensate for this, it was usual formerly to point it to the left; but this position did not obviate the tendence to twist. The remedy for this inconvenience, contrived by Mr Small, is to give the coulter a short knee to the left, immediately below the beam, and thus to point it downwards in the perpendicular of the land side.

Rotherham plough.—This plough, it is said, was invented or improved by Mr Foljambe, of Eastwood, in the West-Riding of Yorkshire, about the year 1730; and from bearing the name of the Dutch plough, it is supposed that it was originally introduced into England from Holland. It is still in very general use in Yorkshire. Mr Foljambe obtained a patent for this plough; but it was afterwards set aside, on the ground that it was only an improvement, and not an original invention. Fig. 1. Plate 3. is a representation of this plough, of which a description has been already given. Fig. 2. is a plan of the same plough. AB is the beam; CB the larger handle or stilt fixed to the beam; DE the smaller handle; EFGI the mould-board; GH the feather of the sock or share; K an iron rod to give strength to the handles.

Small's plough—James Small, the improver of the plough which bears his name, was born about the year 1740, in the county of Berwick in Scotland; finished his apprenticeship under a country carpenter and ploughmaker in the same county; went to Doncaster, and wrought for some time with a waggon and wheel-carriage-maker; and, after his return in 1763, settled at Blackadder Mount, in Berwickshire, where he commenced the business of agricultural implement maker. At the same time he had a considerable farm in his occupation, which gave him the best opportunity of carrying on his experiments. At this time the old Scotch plough was the sole implement in use in that county. Some writers, who seem disposed to detract from Small's merit in the improvement of the plough, are anxious to prove that his claim is to be limited to the introduction of the Rotherham plough, or merely to its revival; for it is asserted that it was known in Scotland as early as 1730, about the time that it was improved by Foljambe in England, by means of an itinerant ploughmaker of the name of Lummas, or Lummis. When Mr Lummis constructed his ploughs we are not informed; but it is added, that the same kind of plough was made by Mr Dalziel in Linlithgowshire, who had been sent to England at the expence of Lord Stair, to be instructed in the best methods of constructing agricultural instruments. From this it appears that Mr Lummis's improvement in the plough had twice fallen into oblivion, and was first restored by Mr Dalziel, and afterwards by Mr Small. But there is something not very distinct in this account of the origin and progress of Small's improvement.

On the other hand, it is strenuously contended by the friends of Small, that the old Scotch plough was the foundation on which he proceeded; and in support of this opinion, the similarity of construction between the Scotch and the improved plough, and the testimony of those who were witnesses of the experiments which he conducted, are adduced. But, at the same time, it is admitted that he was well acquainted with the Rotherham plough; and is it not extremely probable, that, in contemplating the means of improving that implement, he would be desirous of studying the advantages and effects of every plough which he had an opportunity of subjecting to his examination?

Fig. 3. Plate 3. is a view of Small's plough. AB is the beam, CB the left handle, DE the coulter, GH the sheath on which is fixed the sock or share DFG; GHIK the mould-board; AF the sole. Fig. 4. is a plan of the same plough: AB the beam; BC the left handle, DE the right handle; FG the mould-board; I an iron rod which connects the two handles.

The materials of which Small's plough was originally constructed were similar to those of other ploughs; but about the year 1780, he added another improvement, by forming the mould-board and the land-side plates of cast iron; and finding these to answer the purpose so well, he extended the use of the same metal to the sheath and head. The most difficult parts of the plough being put into the hands of the workman ready made, the construction became easy, and its use spread rapidly over Scotland. But the introduction of this plough, like many other useful inventions and valuable improvements, at first met with great opposition. When this was overcome, many ploughmen in Berwickshire were so convinced of the superior advantages of this plough, that for their own ease and satisfaction they offered to be at the sole expence of the wood work, if their masters would furnish them with Small's plough, and defray the other charges. After the use of Small's plough became general in his native county, he settled in Mid-Lothian; and the attempt to introduce it met with similar opposition. A comparative trial of his plough with several others took place near Dalkeith, in presence of a great assemblage of gentlemen and farmers from the surrounding counties. It was decided that his plough did the best work with the least power. The superiority of his plough being thus publicly acknowledged, its use spread rapidly over Scotland, and it has since been extended to many parts of England, as well as to Wales and Ireland, and even to some foreign countries. The late Lord Kames was a warm patron of Small, and in his Gentleman Farmer strongly recommended his improved plough, which he says is now in great request, and with great reason, as it avoids all the defects of the Scotch plough. Before the introduction of this improved instrument, every plough in use required not fewer than four horses or oxen, or a couple of each of these animals, and sometimes more, besides a driver and other attendants; but with Small's plough, two horses and the ploughman are only necessary.

Advantages of Small's plough.—The great superiority of Small's plough arises from the neater and lighter construction of its different parts, the improved combination of these parts, and the exact coincidence of the line of draught and the centre of gravity of the plough. The sock and mould-board are formed according to strict mechanical principles; those parts which enter the earth, have an equally tapering or sharpened wedge like form, which produces the least resistance in raising the furrow-slice; and the mould-board is so curved or twisted, that the friction is diminished, and the furrow-slice is raised and turned over into its most proper place. The an-

Implements.

terior part of this plough is a very thin wedge, so that it cuts the furrow-slice from the fast land with the smallest possible resistance. Aided by the broad thin feather of the sock, which separates the slice below from the sub-soil, and the mould-board gradually increasing the wedge form, the slice is gradually turned over, so that the whole resistance is not met at once.

But the superiority of Small's plough has been fully established by various comparative trials. In an experiment before the Dalkeith Farming Society, it was found, that Small's plough when it operated on an old ley, was drawn with a force of from nine to 10 Cwt. while the old Scotch plough in the same field required a force of 16 Cwt. to execute the same work. In another experiment made before the same society, January 18. 1810, in which a plough improved by Mr Veitch was brought in competition with Small's, it appeared, that a power of draught equal to $3\frac{3}{4}$ Cwt. measured by the dynamometer, applied to the former, produced a furrow of $7\frac{1}{2}$ inches deep; and the same power applied to the latter formed a furrow of $8\frac{1}{2}$ inches deep, and of the same breadth. Another experimental trial of Small's plough in competition with one brought forward by Mr Simpson, exhibited before some members of the same society on June 19. 1813, afforded a still farther proof of its superiority; for it appeared that the latter required a greater power of draught, amounting to nearly $\frac{3}{4}$ Cwt. to perform the same work. Small's ploughs are still made by the sons of the improver, at their manufactory, Leith Walk, Edinburgh.

This plough is sometimes entirely constructed of iron. The chain which was applied to it, seemed to serve no other purpose than giving strength to the beam, and is now very generally disused.

Mr Liston's plough.—A plough invented by the Rev. Mr Liston of Ecclesmachan, and for which that gentleman has obtained a patent, differs from others, first in the form of the mould-board, and, second, in the application of a wheel. 1. The different mould-boards, it is observed by the patentee, which are made by tradesmen, are formed rather by guess than according to any fixed rule; and although they all perform the work proposed, it occurred to him that a mould-board constructed on the principle of adapting the curve to the varying resistance of the furrow to be turned over, would possess many advantages. The undoubted superiority of the work executed by this plough, and the ease of draught obtained, are properly stated as satisfactory proofs of the correctness of the principle on which the construction has proceeded.

2. The diminution of friction is another advantage connected with this plough. This is effected by means of a wheel set at an angle to the horizon, running in the corner of the furrow, and answering the ends both of sole and side-plate, although we understand that some practical farmers have used the plough without the wheel, and have not perceived much difference in its operation.

The advantages of this plough are stated to be, the better performance of the work, with less labour to the horses. The superiority of work consists in the depth of the furrow, and in the complete manner in which the slice is taken out from side to side. On examining the operation of other ploughs, it appears, that although the furrow may be pretty deep on one side, yet great part of the soil is left fast on the other. Wherever deep ploughing is required, as in fallow, the superiority of this plough is universally acknowledged; and it is said that his ploughs, in fallow, can execute as much work as three of any other description, with a clean furrow, and half as deep again. These are valuable properties, and, from authority which we deem unquestionable, we have been assured that they belong to this implement, the advantages of which we suspect have not yet been fully appreciated. Mr Liston's plough is constructed by Mr Morton, agricultural implement maker, foot of Leith Walk, Edinburgh.

An objection has been made to the use of this instrument, in ploughing ley ground for a seed furrow, that the work is too large, or that there are too few *seams* for the reception of the oats or other seed. The objection, it is admitted, is not altogether inapplicable to the plough, as it is at present constructed; for it was calculated solely for strong soils, with a deep and large furrow. But a smaller instrument could easily be made on the same principles; and this task, should leisure and encouragement offer, we understand the ingenious inventor has it in contemplation to undertake.

Sect. II. *Of the Harrow.*

After the operation of the plough, the fresh surface frequently requires to be broken down and pulverized, for the reception of the seed; and when the seed is inserted, it must be covered up. For these purposes, harrows of different weight, and somewhat different in construction, are employed.

Brake harrow.—The brake is a large and heavy harrow, which is used in breaking down stiff soils, as in fallow operations, where the ordinary harrow would have little effect. Some of these have been constructed with four square bulls, each side 5 inches, and $6\frac{1}{2}$ feet in length. The teeth are 17 inches long, 12 inches free below, with a heel close to the under part of the bull, to prevent them from being pushed back, and they are secured above with a screw nut. Five teeth are inserted into each bull, so that the whole number is 20. The teeth bend forward like a coulter; but a brake composed of five bulls, and having six teeth inserted in each, is now more commonly employed; and a harrow of this description is drawn by two horses. The construction of the brake with joints, renders it more commodious for the rounding of the ridge.

Uses of the brake.—In the operation of fallowing stiff clay soil, where a repetition of ploughing is necessary, a braking between each ploughing is of great advantage in pulverizing the soil, and in facilitating the succeeding parts of the labour. In March or April, when strong soil which is overrun with couch-grass and other weeds, is prepared for barley, a cross braking is considered preferable to cross ploughing; and the expence is much less. After ground which has been broken up for the first time, has been cross ploughed, the application of the brake is very effectual in reducing the whole to a proper texture.

Implements.

The harrow has been constructed of different forms and sizes according to the nature of the soil, and the work to be performed. The following is a description of an improved harrow.

Improved Scotch harrow.—Fig. 5. Plate 3. is a plan of an improved harrow. ABCDEFGH, are two harrows connected together by a crank or hinge at L and O, at the extremities of the iron bolts KL, LM, NO, and OP, which pass through two of the bulls in each harrow, and are secured by a nut. Each harrow consists of four bulls, each bull containing five teeth, or tines, making altogether, in the pair of harrows, 40 teeth. A cross bar, AT and CW, in each harrow, is fixed to three of the bulls, to give sufficient strength to that part from which it is drawn. VW is the chain to which the cross-trees are attached. The rhomboidal form of this harrow prevents the teeth behind from running in the track of those which have preceded them. Each tooth has its own distinct track, and all the tracks are at equal distances, as will appear by casting the eye on the figure, from which, and the annexed scale, the proper dimensions may be obtained. Fig. 6. is a profile view of one of the bulls: AB the bull; C the end of the chain which is attached to the cross tree; DF and EG the first and the last teeth. This set of harrows obviates the defects of those of the common form; and being connected by the hinge, they accommodate themselves to the curve of the ridge. For the purpose of covering grass seeds, smaller harrows, with short teeth, are recommended by some, while, by others, the common harrow is supposed to be quite sufficient for this work.

Operation of harrowing.—In the operation of harrowing different soils, and in different conditions, two or more implements, as it may be thought necessary, are wrought together. On stiff soils, two only should be employed, otherwise the work is less perfectly executed by their irregular action; and, on strong coarse soils, as the velocity adds to the effect, the horses should proceed as fast as they can easily walk.

When the harrowing is for the purpose of covering the seed, the greatest attention should be paid to perform the work in a regular and steady manner; and particularly to keep the teeth of the harrow clear from all obstructions, such as grass roots, unbroken masses of earth, and stones, by which the seed is thrown together in crowded patches in some parts of the field, while bare spots appear in others.

To perform the operation of harrowing perfectly, the furrow should be broken, and the surface rendered smooth. The first harrowing is usually in the direction of the ridge lengthwise; the second is conducted transversely or across the field; and the operation is finished by repeating the longitudinal course. Those who are anxious to have the work neatly executed, take care to have the last harrowing precisely in the direction of the ridge.

Sect. III. *Of Drilling Machines.*

Various machines have been constructed for the purpose of depositing grain, pulse, or other seeds, in rows, at equal distances; but few of those which have been invented at different times are found to accomplish the task with the requisite degree of accuracy and regularity. In the construction of machines of this description, simplicity of form, that they may be easily managed by ordinary labourers; cheapness, to admit of being generally employed; regularity in depositing the seed, without bruising or breaking it, and being accommodated to different distances, to suit the size of different seeds,—are the principal circumstances which ought to be attended to. Drill machines vary in form, according to the number of rows which they sow at one time, the distances between the rows, and the kind of seed deposited. In general they are drawn by horses, but sometimes they are moved by the labour of man. The choice of implements of this kind must be regulated by the nature of the soil and situation, the size of the farm, and the kind of grain cultivated; but simplicity of construction, from which the best work may be expected, should be always kept in view.

Numerous instruments have been constructed for facilitating the drill husbandry, as drill-ploughs, drill-rakes, universal sowers, horse-hoes, &c.; but as many of these implements are extremely complicated, and are therefore deficient in the essential character which can render them useful, we shall only describe the drill-roller, the drill-harrow, and the drill-barrow.

Drill-roller.—This roller, which it is supposed was invented in Norfolk, is so contrived as to form regular incisions, or drills in the soil, of a proper depth for the seed. It is a common roller of iron, of about a ton weight and seven feet long, about which are put cutting wheels of cast-iron, which turn round the common cylinder, and are unconnected with each other. The roller is drawn by three or four horses abreast, and driven by a man raised behind them. The cutting wheels are moveable, and, by means of washers, may be fixed at any requisite distance.

The length of the roller may be varied, according to circumstances, and the ribs may be deep or shallow, according to the depth of the drills, and the distances of the rows. The common length is from seven to eight feet; and, if the distances are eight inches, the roller contains 12 ribs. The usual diameter of the roller is 12 inches.

Mode of operation.—The method of operating with this implement is the following: When the ground is ploughed which is intended for setting or dibbling, the roller is drawn across the furrows, and divides the whole field into drills, according to the distance between the cutting wheels. The seed is then sown broadcast, in the usual proportion, and the land is bush-harrowed. In this way the seed is deposited at an equal depth, as in drilling, and the crop rises free from the furrow-seams, which is always an inconvenience connected with the common method of broadcast sowing.

Advantages.—The use of this simple implement is held out as a great saving of both time and expense, and affords all the benefits which are derived from the operation of drill-ploughs, or other complicated apparatus, or from the practice of dibbling, and setting corn by the hand. A man and three horses, it is said, can cover five or six acres of corn in one day. The drill-roller was at first chiefly employed on clover or other grass leys, on the first ploughing; but it is stated to be equally applicable to land which has been several times ploughed.

Drill-harrow.—Fig. 7. Plate 3. is the profile or elevation of a harrow which answers well for cutting weeds and pulverising the soil between the drills: B is the plan of the same machine; C is the profile, and E the plan of the front share; D is the profile, and F is the plan of the hinder share. These shares can be placed at a greater or less distance, according to the width of the drills, as may be seen by consulting the plan B, Fig. 7.

The drill-harrow is a useful instrument for cleaning potatoes, turnips, and other crops in drills; for it both cuts the weeds and harrows them to the surface. Comparing it with the scraping and paring plough, one-half of the expense is saved.

Drill-barrow.—This implement is for the purpose of sowing grain in drills. Fig. 8. Plate 3. is a representation of the various parts of a machine of this description: A is a profile or elevation: B is a plan of the same implement; C is an end view; D is an edge view of the seed-wheel; E is the profile of the same wheel with flutes or channels to receive the beans, and also a brush made of stiff bristles, placed above the wheel, to cause the seed to drop regularly into the bottom of the furrow; F and G, different views of the seed-wheels for sowing oats, barley, wheat, and pease. These different wheels may be placed on the axle or taken off at pleasure, according to the kind of grain to be sown.

This drilling implement is constructed by Messrs Small, Leith Walk, and by Mr Morton, at the same place, at the price of from two to three guineas. The box should contain from a peck to a peck and a-half of grain. The fluted rollers are made either of wood or of cast-iron, which is preferable to having the brushes closer.

Sect. IV. *Of the Grubber.*

Various implements, under the denomination of *scarifiers*, *extirpators*, *cultivators*, &c. have been invented for the purpose of stirring the surface of land and preparing it for the seed, with the view of saving the time and expense of a ploughing. The following is a description of a machine of this kind, called the *grubber*, which has been successfully employed by Mr Dudgeon, in Prora in East Lothian, in Scotland, and is drawn up, at the desire of the Highland Society of Scotland, by Mr John Shirreff.

Construction.—This implement consists of two strong rectangular frames, the one including the other, and nine bars mortised into the inner one, with 11 coulters or tines, with triangular, sharp-edged, dipping-feet; four cast-iron wheels, two handles, &c. The machine is made of various sizes, and elm is reckoned the best wood for the frames and bars. The dimensions of Mr Dudgeon's grubber are the following: See Plate 3. Fig. 9. which is a profile of the implement, and Fig. 10. which is a plan of the same.

	F.	I.
Length of the outside frame -	6	9
Breadth of the frame -	3	6
Square of wood of frames and bars	0	3
Long hinder swing-tree, K K	5	10
Short hind do. N N -	3	6
Coulter's length - -	2	2
——— breadth - -	0	$1\frac{1}{4}$
——— thickness - -	0	$0\frac{7}{8}$

The inner frame is moveable on hinges, fixed on the front beam of the outer; and it has two sides or beams, into which are mortised nine cross-bars, about eight inches distant from each other. The coulters are fixed in these bars, excepting two, which are placed in the side-beams of the outer frame. The openings for the coulter have plates of iron, above and below, for strengthening the wood, with top and heel wedges attached by chains; and when the machine is at work, these wedges are firmly fixed, to steady the coulters. The machine is supported by four cast-metal wheels, each 20 inches in diameter, and they prevent the coulters from going deeper into the soil than the pitch at which they are set by the pins and wedges. The wheels are also necessary for moving the machine from one place to another: and in going down a declivity, the fore-wheels should be dragged, to prevent it from running against the horses. When the instrument is to be removed from one place to another, the screws AA, Fig. 10. are turned to allow the inner frame to rise on the hinges near EE. The inner frame is raised by the handles B B, and supported by small iron-stays, which are hung on staples CC, and stretch to others on the under side of the bars DD, Fig. 9. When the implement is at work, these stays lie across the frame, and are fixed in other staples at EE, Fig. 10. To strengthen the inner frame, two rods of malleable iron, headed at both ends, run from near DD to near EE, Fig. 10. The two coulters fixed in the side-beams of the outer frame must have the wedges slackened, and be raised close up to the under side of these beams, and fixed there, when the instrument is moved from one place to another. At FF, Fig. 10. in the outer frame, bolts are driven upwards, with screwed points, and fastened with corresponding screws. The lower ends of these bolts have eyes or round holes, for fastening the extremities of the chains HH, which are attached to the large swing tree at KK. The soam L is fixed below the inner frame at G, passing through a strong staple under the outer frame at M. NN are small swing-trees, to which the two hindmost horses are yoked. The coulters stand reclined, and have steel triangular feet, as may be seen at Fig. 9, and under different views in the separate figures Q, Q, Q. They are from three to four inches broad at the base, and from five to six inches long from the base to the point of the triangle. The beam PO, Fig. 9. of the inner frame, must have the under edge rounded off, to allow it to rise by the handles.

Use of the grubber.—To work, and thoroughly stir summer fallows, or land on which potatoes or turnips have been raised, or lands ploughed in autumn or the winter, and which are intended to be sown with grain or pulse in the spring, with the exception of clover and other leys, are the important purposes to which the grubber may be applied. Sowing on the winter furrow has been objected to, because the effects of a spring ploughing to clean the ground are lost. It is no favourable indication of the state of the ground which renders spring ploughing necessary, with this view; but in such cases the grubber will be found a valuable instrument: For grounds in such a condition can be effectually stirred as deep as the plough goes, and all root weeds which have remained in the soil are cut up, and drawn to the surface, by the reclining position of the coulters, and sharp edges of their feet, instead of being partially buried by the operation of ploughing. The grubber acts as a powerful harrow, with the additional effect of its sharp edged triangular feet; and it does not materially alter the relative position of the particles of the soil; and hence it affords a decided advantage over the plough for working winter ploughed lands in the spring, particularly those of a strong nature, for the valuable part of the mould is retained on the surface for the reception of the seed. By the use of this instrument, time, and consequently expense, are saved; early sowing is obtained; no fresh seeds of annual weeds are brought near the surface; and a drilling apparatus might be connected with it, to deposit grain or other kinds of seed.

Advantages.—In cases where lands have been laid down with cultivated herbage seeds, as red-clover, &c. and have been broken up and cropped with oats, which are to be succeeded by beans, if the oat stubble have been ploughed down in the autumn, or early in winter, the land may be afterwards advantageously wrought by the grubber in spring, and the beans put in by a separate drilling apparatus, or one attached to the grubber itself; and if a skim-coulter were employed to bury the oat stubble under a strong deep furrow, the grubber would afterwards complete the operation. Beans, pease, and tares, have been sown on the winter furrow, merely by working the land with the grubber; and in some cases the land, after sowing, has been wrought and cleaned very effectually with this instrument. The feet were so set as not to reach the seed, which was drilled; but if the operation be not delayed till the roots have taken hold of the soil, it may be employed without injury, both in drill and broadcast crops.

The grubber is also found extremely useful in aiding the operations in the preparation of land for potatoes or turnips, as well as for summer fallow. Land which has been previously ploughed in winter, or early in the spring, when it is of a friable nature, may be cleaned and pulverised as soon as the dry weather sets in, by means of the grubber. When the ground is foul, the instrument may be set to work only a few inches deep in going over the field the first time, and the coulters may be placed deeper and deeper as they can be applied. After two operations of the grubber, in very foul land, it is found necessary to use the plough, which is to be followed by the grubber again, till the land be as clean as can be effected. In a strong soil, a second ploughing, to be succeeded by rolling, may be required before the cleaning process of the grubber can be repeated. When stiff soil has been twice ploughed and rolled, the root weeds are, in almost all cases, loosened and brought to the surface by the grubber. When there is much couch-grass in the soil of a field, it may be divided into several compartments by plough furrows; in crossing these, the inner frame of the instrument can be raised up, and the root weeds, collected by the coulters, disengaged from them. These weeds, being deposited in parallel rows, are collected by a rake, to be scorched or carried off the field.

An instrument of this kind may be applied to work across and level down the ridgelets formed in horse-hoed drilled beans, after the crop is removed, and previously to ploughing down the stubble. The grubber effectually exterminates couch-grass or other root weeds left in a bean fallow, and which are usually found on the tops of the ridgelets, lurking among the stems of the beans. The levelling of the ridgelets, which admits of the land being ploughed with more facility, correctness, and expedition, is effectually accomplished by means of the grubber.

If seed can be advantageously inserted in a very dry autumn, in strong land, by means of the scarifier instead of the plough, it cannot be doubted that it may be more easily done on moderately loamy soils by the grubber, and in all soils of a softer texture, early in spring, before they are hardened by the drought. If fewer coulters were employed, if it had only five or six instead of 11, and if it were only half the breadth, and the same power applied, this instrument might probably be used in the preparation of land after turnip, for the reception of barley and grass-seeds, to better purpose than the plough, by stirring the soil completely, while the seeds of annual weeds are not brought near the surface.

These implements are drawn by four horses, and they are constructed by Messrs Brown and Carrick, farm implement makers in the village of Athelstoneford, East-Lothian. The price of grubbers of the strongest construction is from L.11 to eleven guineas; and they are also made by Mr Morton, Leith-Walk, Edinburgh.

Sect. V. *Of the Roller.*

Rollers are constructed of wood, cast-iron, or stone; and they are drawn over the surface of the land by means of horses, for the purpose either of reducing lumps or clods, or for compressing porous soils that their texture may be improved. The roller is employed both for tillage and grass lands; and the weight and size are different, according to the different uses to which they are applied.

The common roller is about five or six feet long, and from 15 to 30 inches in diameter; but when it is intended for flattening one *bout* ridges, to prepare them for drilling turnips, it is made shorter and of smaller diameter. A roller of cast iron, and divided into two parts, is recommended as one of the best construction. The length of each of the parts is from three to three and a half feet, so that a surface equal to six or seven feet is covered. It exceeds 10 Cwt.; the frame is strongly made, with shafts for a single horse, to be fixed on the near side, and hooks placed on the other side for an additional horse when necessary. The gudgeons, or pivots, act upon small case-hardened friction wheels, two of which are fixed on each side of the frame, with a small roller of hard wood, about nine inches long and three inches in diameter, bound with iron at the extremities, and fixed to the back part of the frame, that both rollers may act with each other in the centre

Implements. wheel. In this way, while the large roller is kept steady, the draught is at the same time greatly diminished. The obvious advantage of this roller is, that it rises and falls in the centre, and thus accommodates itself to the slopes of the ridges.

As rollers do not move upon their axis, but are drawn along the surface of the ground, they are apt to tear it up, and to make cavities and depressions before they come into the line of draught, to which they are brought with some exertion, when they are turned at the ends of ridges or fields; the roller now described, from being constructed in two pieces, is supposed to obviate these inconveniencies; and when formed in this way, it is recommended that the cylinders be made of cast-iron.

The spike-roller, which is constructed in the same way as the common roller, except that it has a number of spikes inserted in it, is considered a very efficient implement in reducing strong stiff soils, breaking down the lumps, and bringing the land into a fine state; and a compound roller, composed of the plain and spike rollers, which may be used either singly or together, is also found highly beneficial in producing the same effects. Its powers, it is said, are wonderful, in pulverising stiff clay soils. It gives the farmer a command over dry seasons, and enables him to sow his spring and fallow crops in proper time, and to clean his arable land of root and annual weeds. A roller of this kind, passed over the land once, twice, or thrice, with drag-harrowing between every rolling, renders it sufficiently fine for every purpose. This roller is also found extremely useful in restoring degenerated sward.

The furrow roller, which is a double cone, united at the base, has been constructed for the purpose of rolling the furrows in hilly and other lands which are not accessible to the common roller.

The size and weight of rollers, it is obvious, must be varied according to the nature of the soil and the particular purpose for which they are intended. When the roller is of large size, a greater weight becomes necessary to make any impression, because it is divided over a more extended surface, and when the roller is small, it is apt to produce depressions and inequalities on the softer and more yielding parts of the soil. It would therefore be of great advantage to have rollers of different sizes, and by increasing or diminishing their weight they can be accommodated to all purposes.

Operation of rolling.—In rolling ground with a roller composed of a single piece, the operation is most conveniently performed by going round the whole field in a kind of spiral direction; for in this way the necessity of making short turns is obviated. This is the best method of rolling down grass seeds with corn crops. Grass lands may be rolled in any direction; but perhaps, in all cases, the most convenient and effectual practice is, to roll transversely or across the field, so that the benefit may be extended to the land next the furrow, which is rarely the case when the operation is conducted along the ridge.

Advantages of rolling.—As the object of rolling is to render the soil more solid and compact, and thus to improve its texture, as well as to give it a smooth and even surface, the operation should never be performed in wet weather, particularly on adhesive soils, which are apt to stick to the roller, and to render the surface rough and uneven; but when it is employed in a favourable season, it is of great use in breaking down the hard masses of earth which are turned up in fallowing. It is not less beneficial in the preparation of land for turnips, and it is equally useful to grass lands after they are cleared of stones. A heavy stone-roller, drawn by two, or even by three horses, is required for strong clay soils; but for grass or turnip land, a wooden or cast-iron roller, drawn by a single horse, is sufficient.

SECT. VI. *Of Reaping Machines.*

The usual method of reaping corn by means of manual labour with the sickle or scythe, is often attended with much inconvenience and loss, not only from a deficiency of hands when the crop is fully ripe, but also from the shaking of the grain before and during the operation. These circumstances have suggested the notion of constructing a machine, by which that important work might be accomplished with more safety and expedition. Many attempts have been made for this purpose, but till lately none of them promised to be successful. The splendid premium of L.500 Sterling, which was offered by the Dalkeith Farming Society, a few years ago, to the person who should invent and construct an effective machine for reaping corn, roused mechanical ingenuity, and brought forward a great number of models and machines; but few of them, even from a slight examination of their principle and construction, were calculated to produce the effect. Some of these models or machines operated by means of knives; some by means of scissars, and others by circular cutters; but they were all deficient in one or both of the essential properties of such an apparatus, namely, in the perfect cutting and regular laying of the grain. The only machines of this description which appeared to be constructed on a correct principle, and have been found upon trial to answer the end, are those of Mr Smith, manager of the Deanston cotton-works, near Doune, in Perthshire, and of Mr Kerr, mathematical instrument maker in Edinburgh. Of these machines, the principle of which is exactly the same, we shall give a short description.

Mr Smith's reaping machine.—Fig. 1. Plate 4. is a perspective view of Mr Smith's reaping machine. AB is the frame work, which supports the cutter D, and the machinery by which it is put in motion. C is a conical drum, made of tin-plate or basket work, two feet deep, and about five feet diameter at its lower part, to which the circular cutter D is attached. The drum is covered on the outside with canvas; and perpendicular pieces of soft rope, about an inch thick, and three or four inches distant from each other, are stitched upon it, to increase the friction in carrying round the cut corn. The circular cutter D consists of six segments, which are secured in their place by screw-nails, and can easily be taken off to be sharpened. They are made of German steel, and project five inches beyond the lower part of the drum. The motion is communicated to the drum and cutter by the wheels E E, through the intermediate action of the horizontal shaft FF; and this latter puts in motion the upright shaft, to which the drum and cutter are attached. The horses which propel the machine are yoked to a transverse bar, which is fixed at the extremity of a pole, running back from the frame of the carriage, and they draw by means of common plough chains directly from the cross-bar, or, what is considered as an improvement, by cross or swingle trees. The back weight of the carriage is supported on common cart saddles, with an apparatus similar to that used in curricles.

Operation.—An inspection of the figure will shew that the carriage wheels, by a series of wheels, pinions, and shafts, communicate, in proceeding forward, a rapid rotatory motion to the drum and cutter; and as the cutter projects beyond the carriage-wheels on each side, a sufficient breadth is cut down to permit the carriage and horses to pass along without injuring the uncut corn. The corn is cut by the rapid motion of the cutter; and as the lower ends of the stems rest upon the edge of the cutter, and the heads come in contact with the drum, the whole is carried round, and regularly laid by the side of the machine. The lower extremities take the ground first, the heads fall outwards, and the stalks are laid parallel to each other, and nearly at right angles to the line of motion of the machine. The man who drives the horses walks behind, and guides the whole machine by the end of the pole. By a particular apparatus he can raise or lower the cutter, when any obstacle comes in the way, or in going from one field to another. The cutters require to be sharpened four times in reaping an acre; and this operation is performed in two minutes with a common scythe stone.

When the machine is to be removed to a distance, the upright spindle, with the drum and cutter attached, is taken from its place, and secured on the top of the carriage. The cross bar at the extremity of the pole is removed, and fixed in a mortice near the frame of the carriage, and the horses are turned, to draw from it, so that the machine may travel to any distance, and over any kind of road.

In the trials which have been made with Mr Smith's machine, it appears that it is capable of cutting down an English acre of corn in the hour, during which the cutter, as already mentioned, requires to be sharpened four times. The expence of a machine of this description is calculated at L.30 or L.35 Sterling; but it is supposed that, with proper care, it may be kept in use for many years. The only additional expence will be a new set of cutters every second or third year.

Mr Smith made the first trial of his machine on a small scale, during the harvest of 1811, and it was then wrought by two men. In 1812, he constructed a machine upon a larger scale, wrought by a horse. Several acres of oats and barley were cut down with considerable ease. It was found that the power of a single horse was unequal to push it forward on rising ground. During this harvest, Mr Smith exhibited his machine in operation in the neighbourhood of Dalkeith, before a committee of the Dalkeith Farming Society, from whose report it appeared that the corn was well cut, but was not laid with sufficient regularity. In the succeeding year, 1813, the machine was still farther improved, when it was wrought by two horses and one man. It was again exhibited before a committee of the Dalkeith Farming Society, who reported that the corn was better laid, but was imperfectly cut. In the harvest of 1814, some additions were made to the apparatus, for the purpose of regulating the application of the cutter when it is employed on unequal ground. This addition consists in wheels or rollers, placed under the cutter, by which it is prevented from sinking into the earth on a rough surface. But the most successful trials with Mr Smith's machine were made in the harvest of 1815, some of which were in the presence of a committee of the Highland Society of Scotland, who gave a most favourable report of its operation; and as an acknowledgment of their opinion of Mr Smith's ingenuity, a piece of plate of 50 guineas value, was presented to him by that respectable body. In the trials alluded to, a Scotch acre of beans was cut down in an hour and a quarter. Satisfactory trials were also made in reaping wheat and oats, the latter of which was laid with the most perfect regularity, at right angles to the path of the machine. The operation of this machine in cutting corn is attended with the great advantage, that the grain is not in the least degree shaken; so that the loss which is frequently sustained by the common mode of reaping with the sickle is entirely avoided.

Mr Kerr's reaping machine.—This machine, of which a perspective view is given at Fig. 2. Plate 4. consists of two principal parts, 1st, the carriage, and, 2d, the drum, with its appendages. The carriage is mounted on three wheels, and is partly of wood and partly of iron. The two front wheels are made very heavy, in order to give power to the cutter. The rim is about six inches broad. These wheels move upon a strong axle, which has a catch to carry round the axle with the wheels when the machine is pushed forward, but so fixed as to leave the axle free when the machine is drawn backwards. Upon this axle the two bevil wheels are fixed, only one of which is shewn in the figure at D. They are so placed that either of them may be brought into action, and thus the motion may be reversed at pleasure. The ends of the main axle move in couples, connected with a strong bar, or bars, passing below the cutter to the frame of the machine. A broad upright beam, or frame work, E, is attached to the bar immediately behind the cutter, on the top of which the long beam EF rests, and the whole is bound together with straps and bolts of iron, so as to form a strong and durable carriage. The third small wheel is placed near the bottom of the upright frame-work E, and the machine thus resting on the three points, sufficiently distant, is not easily overturned. The horses are yoked to the end of the long beam by swingle-trees at F. The horse was yoked by a swingle-tree at the first trial of the machine in harvest 1811, and this method is found to produce by far the most steady motion. The two guards GG prevent the horses from coming forward on the cutter, in the event of any of the harness giving way.

The drum A forms the other part of the machine, and it consists of a frame with iron arms, which are bounded by a circular rim. The arms are covered

Implements.

on the outside with thin wood, or basket-work, which commences immediately above the cutter B, and is continued as high as the heads or ears of the growing corn. The cutter, or perpetual scythe, B, is fixed to the bottom of the rim. It is sharp on the outside, or outer edge, and is divided into a convenient number of segments, all of the same size, so that a corresponding part may be easily put on, in case of any of the segments being damaged. The drum is carried round upon an upright shaft or axis D, passing through its middle. There is a pinion fixed upon this axis, which pitches in one of the toothed vertical wheels on the main axle, so that when the carriage moves the drum is immediately put in motion. The lower end of the pinion-shaft or axis rests on a part of the frame directly over the middle of the main axle, and the upper end of it is kept in its place by the end of the long beam above, which is produced to E for that purpose.

By this arrangement, the whole forms a strong, compact, and simple machine, of which the new invention of the drum, with the circular cutter attached, makes the most important and distinguishing feature. Many machines have been constructed for reaping corn, by some of which the cutting process has been accomplished; but none of these machines can cut and at the same time lay down the corn regularly, so as to be afterwards operated upon by the thrashing machines now in general use. Both these, however, are done in the most perfect manner by this machine. The stalks of corn after being cut, are laid down with their heads away from the machine, so as to form a right angle with the line of operation, or path of the horses, and by this means they may be easily gathered into sheaves.

Mr Kerr's new invention of the drum and circular cutter attached, was not made very public till the month of February 1811, at which time he exhibited his model in its present complete and simple form. Soon after this, we find it was laid before one of the first agricultural societies in Scotland, and they entered the date of the exhibition upon their minutes, in order to secure to him the merit of the invention. This appears by the following excerpt from the minute-book of the Dalkeith Farming Society, dated 11th April 1811: "One of the members having mentioned that he had seen a very ingenious model of a reaping machine, which the inventor, Mr Kerr, mathematical instrument maker in Edinburgh, was desirous to exhibit to the Society, for the purpose of securing to himself the priority of invention, in the event of an effective machine being afterwards constructed on the same principles; the meeting agreed that the secretary should inform Mr Kerr that they would examine his model at next meeting." The model was accordingly presented in the month of May following, before a very full assembly, being the anniversary meeting of the Society, and the committee delivered their report, which is also inserted in their minute-book.

In the harvest of the same year (1811) Mr Kerr constructed a large operative machine, and proved the efficiency of the principle of his invention on a field of corn near Edinburgh. The price of this machine it is supposed will not exceed L.20 Sterling. Mr Kerr obtained a premium of 20 guineas from the Highland Society for his model, which was examined by a committee of the directors; and he is to receive a farther sum of 20 guineas when he constructs an improved machine on a large scale. To those who are interested in the perfection of such an implement, it will be gratifying to be informed, that he is now occupied in this labour; and to those who are acquainted with his talents and ingenuity, it is needless to state, that something effectual may be expected from his exertions, and particularly when the various improvements which he has in contemplation have been arranged and embodied. It is proper to add, that Mr Kerr has already taken the preliminary steps to secure the right of his invention by a patent, and we believe it is still his intention to complete the process.

The slightest inspection of the figures of the two reaping machines now described, is sufficient to mark the identity of the principle in both. The construction is somewhat different. But whether the complicated apparatus in the one be necessary to its successful operation we presume not to decide; nor should we deem ourselves free from equal presumption were we to pronounce any decision on the merits of a controversy, which we regret has appeared before the public with regard to the priority of invention and certain improvements on these machines. On one point we have no hesitation in expressing a decided opinion. Since we had an opportunity of seeing Mr Kerr's model, and of witnessing the operation of Mr Smith's machine at Dalkeith, in 1813, we have never entertained the smallest doubt that an efficient reaping machine could be constructed.

Sect. VII. *Of the Thrashing Machine.*

The invention of the thrashing machine has been productive of more real benefit to the agriculturist than perhaps any other instrument at present in use. Besides the immense saving of grain, not only in regard to quantity, but its improvement in quality, he can at all times command a sufficient supply, either for an increasing demand in the market, or in the field in seed-time. From the rapidity with which the operation can be performed, he has it now in his power to attend to it at all times, which formerly, from its very nature, when executed by the flail, became impossible, as it generally commenced immediately after harvest, and continued, according to circumstances, frequently during nine months of the year. Independent of seeing the whole process performed in the most satisfactory manner, under his own eye, the grain is not now required to be in the chaff heap, during the thrashing of a stack, for perhaps ten or fourteen days, on a damp floor, until it is winnowed, but is in general immediately passed through the fanners a second time, which operation, with the thrashing, seldom occupies more than two days, and in many cases it is finished in a shorter time. The advantage derived from the quickness of this operation is perhaps greater with regard to wheat than any other grain; for by lying so long in the chaff heap, it contracted a degree of toughness which rendered it difficult to grind immediately after thrashing; so that it became necessary either to remain on a well aired floor for some time, or to mix it with a larger quantity which had been dried in a similar situation. The grain also acquires a kind of roughness to the touch by lying in the chaff, so perceptible, that few persons who are in the habit of judging of the quality of grain, are at a loss to know whether it has been thrashed by the flail or the machine; an accurate observer assures us, that he has frequently made the experiment in the public market, and has been seldom disappointed in the result.

Origin and history.—The first attempt to construct a thrashing machine seems to have been made about the middle of the 18th century, by Mr Michael Menzies, advocate. This machine, for which the inventor obtained a patent, was erected in the vicinity of Edinburgh, and, after being examined by a committee of the Society of Improvers in Scotland, was approved and recommended by that body. The machinery was driven by water, and the operation was performed by a number of flails, somewhat similar to those which are used in thrashing by manual labour; but it did not answer the purpose, and soon afterwards was laid aside.

The next attempt to construct a machine of this kind was made, about the year 1758, by Mr Michael Stirling, a farmer near Dumblane, in Perthshire. The principles on which this machine was constructed are similar to those of the flax or lint mill. An upright shaft or axle, driven by a water-wheel, has four arms fixed in it, which are inclosed in a cylinder, about 8 feet in diameter and $3\frac{1}{2}$ feet in height. The shaft and arms are moved with great velocity within the cylinder, and the corn, which is presented by the hand, is let down through an opening in the top of the cylinder, that it may receive the strokes of the arms or switchers by which the grain is beaten out, and the straw passes outwards through an opening in the side of the cylinder. The corn falls down into the fanners to be separated from the chaff. This kind of machine, although it is not considered of the best construction for separating the grain from the straw, is still in use in some parts of Scotland.

Two thrashing machines were erected in Northumberland about the year 1772. One of them was invented by Mr Ilderton, at Alnwick, and acted upon the principle of pressing or rubbing out the grain; but it would appear that the work was very imperfectly executed. The other machine alluded to, was constructed by Mr Oxley, at Flodden, and its operation, it is said, was more successful. By some it has been alleged, that Mr Meikle, who is generally considered as the inventor of the thrashing mill, derived the first hint from this machine, which was moved by horses, and the corn was introduced between two fluted rollers, and struck by switchers hung on hinges. The defect of this machine was, that it did not thrash out the grain completely, arising, it is supposed, from the want of sufficient velocity. Before this time, a thrashing machine, upon the principle of the flax mill, was erected in Northumberland, by Mr Gregson, who, it is said, borrowed the idea from a small flax mill, with which a Scotchman travelled the country, for the purpose of swingling the flax which the farmers grew for their own use. Mr Gregson's machine was wrought by a man, who could thrash with it twelve bushels of wheat in a day; but it was found to be hard labour, and the machine was soon afterwards laid aside.

It appears that models of some of the thrashing machines erected in Northumberland, were brought to East-Lothian, one of which was sent to Mr Andrew Meikle, civil engineer at Houston Mill, near Haddington, for the purpose of ascertaining its effects; but on the trial being made, the model was, in a few minutes, broken to pieces; and the machine constructed on a large scale, some years afterwards, shared the same fate. From these unsuccessful attempts, Mr Meikle was probably led to turn his thoughts to the construction of a thrashing machine, upon a different principle from any which had been yet adopted. He employed a cylinder or drum, placed in a horizontal position, and having the switchers fixed upon its circumference, so that it might be enabled to bear the necessary motion; for he was convinced that the corn could not be perfectly detached from the straw without a very considerable velocity in the thrashing drum. The attempt completely succeeded.

The first thrashing machine was erected by the son of the inventor, about the year 1786, at Kilbagie, in Clackmannanshire; and it is not a little curious to observe the doubts which were then entertained of the successful operation of such a machine; for a stipulation was entered into, that the materials were to be furnished by the proprietor, and if the machine did not answer, no remuneration was due to Mr Meikle for his labour. When the machine was completed, it performed the work in a satisfactory manner. Other machines were erected on the same principles; and their utility and advantages being fully established, a patent for the invention was obtained, but proved of little benefit to the ingenious inventor, in consequence of the numerous machines which had been constructed in different parts of the country. Not long since, the ingenuity of Mr Meikle, then in his 89th year, was rewarded by a pretty liberal subscription, which was encouraged and promoted chiefly among the landed proprietors and farmers in the northern part of the kingdom.

Since the invention and first construction of the thrashing machine, various important improvements have been introduced, both by the inventor himself, and by other ingenious mechanics. When it was first erected, although the corn was well separated from the straw, yet as corn, straw, and chaff, were thrown together into the same heap, the operation was only half performed; but by means of shakers and fanners, which have been added to the original machine, and are driven by the same power, the operation of thrashing, shaking, and winnowing, is executed at the same time, and the grain is immediately prepared for the market.

For the following description, as well as for the elegant drawing from which our engraving is taken, of a very complete and perfect thrashing machine, we are indebted to Mr Clark, of Mayfield, near Dalkeith, on whose farm it was erected by Mr Charles Umpherston, mill-wright at Loanhead.

A, Fig. 1. Plate 5. is a table 4 feet long by $3\frac{1}{2}$ feet broad, elevated from the opposite side of the rollers

Implements. about 6 or 7 inches, on which the corn is regularly and evenly spread, and, by being pressed gently forward, is taken in by the rollers B, (4 inches in diameter,) and by their weight and triangular edges is held fast, while the switchers *c c c c*, fixed to the cylinder D, and projecting about 3 inches from its surface, passing with great velocity, beats the grain out in an upward direction against the plate E and breast of the machine F, made moveable by hinges at G. The breast of the machine, from the plate E to the hinge at G, is covered with plate-iron; the cylindrical drum D, and switchers *c c*, are also covered with the same metal. The straw and grain are thrown against the circular shaker or rake H, and by it made to pass over the skreen I, through which the grain falls into the hopper K, while the straw is carried forward to the second rake, or cylindrical skreen L, which separates the remaining grain, and throws the straw upon the inclined skreen M, to the floor of the straw-house N. The grain, by passing through the hopper K, is made to fall into the fanners O, which separate the chaff and grain in the usual manner. After being properly riddled, and the chaff removed, the grain is again passed through the same fanners, which are then moved by a small water-wheel, (entirely distinct and separate from the thrashing machine,) placed under the *troughs;* the velocity of the wind required is regulated by a valve, allowing a greater or lesser quantity of water to fall upon the wheel, which completes the operation.

The whole machine is put in motion by the water-wheel P, 14 feet 4 inches in diameter, and 3 feet 9 inches in breadth, made entirely of cast-metal, excepting the arms, which are of hammered iron, and the buckets of wood, pitched; and which, to thrash the grain in a proper manner, requires to make four and a half revolutions in a minute. The requisite velocity is obtained by the quantity of water allowed to fall into the buckets, by raising or depressing a sluice, which is so constructed as to be near the hand of the person who conducts the operation.

On the inner edge of the water-wheel are placed a number of cast-metal segments, containing 240 teeth, which drives the pinion Q, (2 feet 7 inches in diameter,) of 43 teeth, also made of cast-metal, and placed on the axis of the spur-wheel R, (5 feet 9 inches in diameter,) made of the same materials, having 108 teeth, that drives the pinion of the cylinder D, having 12 leaves. On the axis of the spur-wheel R, are also placed two pinions or sheaves S, (1 foot 10 inches in diameter,) which in the plate are seen through the pinion Q, so constructed as to move the chain-belt T, of the rake H and Y, of the roller pinion or sheave W; the motion of the second rake or skreen, L, is communicated from the rake H, by the two bevelled wheels XX, fixed on the axis Y, and working into the two faced wheels ZZ. The chain-belt V, puts in motion the pinion or sheave W, which by a faced wheel *a*, (see Fig. 2.) working into the small pinion *b*, turns the spindle *c*, to the upper end of which is attached the pinion *d*, which, by the lever *e*, can be made to give motion to either of the face-wheels *f* or *g*, fixed on the axis *h*, by which means the motion of the rollers B can be made to feed in the corn, or the reverse, at pleasure. This contrivance is particularly useful in thrashing grain when the straw is Implements. damp, as it has then a great tendency to warp round the rollers, by reversing the motion, which is done by moving the pinion *d*, (see fig. 2.) by the assistance of the lever *e*, from the face wheel *f*, to that of *g*; the rollers are then made to move in a contrary direction, and to return the straw on the feeding table, with the same celerity that it was taken in by them to be exposed to the switchers of the cylindrical drum. All this is accomplished while the machine moves on in the usual manner; and as soon as the straw has *wound* off the rollers, the operation proceeds, by again moving the pinion *d* into the pitch of the face-wheel *f*, as formerly.

Another advantage attending this construction, is, that the pinion *d*, by being left out of the pitch of either wheels, as in Fig. 2., the motion of the rollers is stopped; and as it seldom happens that the water can be entirely excluded by the sluices from the water-wheel, should the machine be set in motion from such a circumstance, or any other, no danger is to be apprehended from any thing left on the feeding table being taken into the machine, which from the negligence of servants may occasionally take place.

On the same axis *h*, with the bevelled wheels *f* and *g*, Fig. 2. are placed two small spur-wheels, of different diameters, (5 and 6½ inches) fixed together by the box *i*, and, being made to move along the axis, can be fixed at any particular point of it by the screw *k*; as these are made of different diameters, and also to work into either of the two, of different diameters, fixed on the axis *l*, to which the rollers are attached, it is obvious that, by these means, the rollers can be made to deliver the corn to the switchers either in a slow or rapid manner, as may be thought necessary from the length of the straw, the proportion, in this case, being as eight to twelve.

In the machine which we have described, the rollers, drum, and rakes, are made four feet in length; this size has been found, by repeated observations, to be preferable to their being made of a greater length. When the water-wheel moves with that degree of celerity necessary to give the proper velocity to the switchers on the cylindrical drum, it is found fully to occupy one man in feeding the corn to the machine (with his assistants to unbind and place it on the table) in a proper manner; and also sufficient employment to the other persons who are engaged to remove the straw and to riddle the grain. When this is exceeded, nothing but confusion takes place, which it is always adviseable to avoid. The quantity which is generally thrashed by this regular method of working amounts to about six bolls per hour; by employing a greater number of persons, and applying more water, double the quantity could be done in the same time, the corn being supplied in a proportionate manner.

The fanners are moved by a crossed rope passed over a sheave about 11 inches in diameter, placed on the axis of the cylinder D, and two others on the axis of the fanners, of eight and ten inches in diameter, and the rope placed on either of them as occasion may require. The rope is directed by the assistance of the two pulleys, *n* and *o*; and as the one

Implements. at o is made to move up and down in a frame, the rope is by that means kept in the degree of tightness that is requisite. As the axis of the fanners make 47 revolutions for one of the water-wheel, the number is 211 per minute.

In calculating the velocity of the above machine, excluding fractions, it will be found that the cylindrical drum makes about 50 revolutions for one of the water-wheel; and as the water-wheel requires to make 4½ turns per minute, the number of the revolutions of the cylinder is 225 per minute; and as the diameter of the cylinder, including the breadth of the switchers, is 3½ feet, the circumference then is nearly 11, making the velocity of the switchers about 2500 feet per minute.

As the rakes make five revolutions for one of the water-wheel, the number, per minute, is 22½, clearing the skreen (having four arms) 90 times per minute.

The rollers are so constructed by the chain-belts, &c. as to make, when upon the slowest motion, eight revolutions for one of the water-wheel, and when the quickest motion is necessary 12 revolutions; by this it appears, that they will, on the former, make 36 revolutions per minute, and the latter 54; and as they are four inches in diameter, the circumference is somewhat more than 12½ inches, which being multiplied by the number of revolutions per minute, makes, when on the slowest motion, 450 inches of straw to pass through the rollers, and when on the quickest 675; which 675 inches will receive 900 strokes of the switchers in that time, or nearly a stroke and a half to an inch. On the slowest motion, the number is exactly two strokes to an inch; and this has been found, by the present machine, always to beat out the grain in the most satisfactory manner.

As the segments containing the teeth for moving the spur-wheel are placed on the inner edge of the water-wheel of the machine, which we have described, and as it is constructed with eight double arms of malleable iron, a considerable improvement was made in erecting it (from those wheels hitherto made on the same principle,) by placing four stays from the outer arms near the gudgeon to the arms on the opposite side immediately under the buckets, by which means the lateral motion from the spring of the arms is prevented, and the machine moves with a more steady and equable motion. It was found that a stay to every second arm completely answered the purpose.

In erecting machines of this description, it is of consequence, as in the case of the present, where situation and circumstances will allow, to convey the water under ground from the mill-pond to the water-wheel; and as the moving part of the sluice is made so as always to be immersed in the water, no interruption takes place in the time of frost; the water-wheel being at the same time defended from it as much as circumstances permit.

When the water in the pond stands at five feet perpendicular height from the level on which it strikes the wheel, the sluice requires to be elevated only one inch; and as the sluice is exactly 24 inches in breadth, the water, under that pressure, issuing through an aperture of 24 square inches, is sufficient to do the work which has been already described; as the water subsides in the pond, it becomes of course necessary to elevate the sluice in a corresponding degree. Implements.

If, from a scarcity of water, or any other cause, it should be necessary to apply a horse-power to move the machine, we have subjoined the following description of a horse-wheel and shaft, applicable to the construction of the other parts of the machinery, and which may be employed either with a small quantity of water, assisted by horses, or entirely by horses.

Fig. 3. AA cross beams; BBB cross bridges for lying shafts; C coupling box; D barn wall; E wall between arch and horse-way; F water-wheel; G part of horse-wheel.

When the thrashing machine is driven by horses or other animals, it is of great consequence that it should move uniformly and steadily; but this is rarely accomplished, except by well-trained animals, or great attention on the part of the driver; and when any irregularity in the motion arises, from the unequal exertion of the horses, no small degree of care is requisite in the person who feeds the machine to obviate its imperfect operation; but as the labour of working the thrashing machine, when long continued, is severe, the fatigued and languid animals exert themselves unequally, and when urged forward make sudden jerks and strains, which is a great waste of their own strength, and produces a considerable interruption and injury to the machine. To obviate these inconveniencies, a very ingenious and simple apparatus has been constructed by Mr Samuel, of the village of Long-Niddry, in Linlithgowshire. The principle of this apparatus depends on the resistance which a horse or other animal invariably makes to be drawn backwards; and it is so constructed by means of sheaves and pullies, that a connection is formed between the draught-chains or ropes of each animal, whether yoked abreast or at different arms of the machine; and in consequence of this connection, when any one relaxes his exertion, he is pulled back by the shoulders, so that he immediately resists and pushes forwards; and in this way the action of the whole is rendered equal.

Fanners.—The fanners, or winnowing machine, which is now in very general use, was introduced into Scotland by the father of Mr Meikle, the inventor of the thrashing machine, about the beginning of the 18th century. In 1710 he was engaged by Mr Fletcher of Salton, a celebrated character in Scottish history, to proceed to Holland for the purpose of being instructed in the art of making pot-barley, and of erecting barley-mills. After his return, he constructed the first fanners for separating the chaff from the grain that were known in Scotland. The original construction was only a wheel with four vanes of thin boards or sheet-iron, which were made to revolve with considerable velocity within a drum, by which a strong current of air is produced, and the chaff and light grain are blown backwards, while the good grain falls downwards by its superior weight. This machine, which has been also greatly improved, is now very extensively employed, and is usually connected with the thrashing-mill; so that when it is properly fitted with riddles, or harping apparatus, the grain is cleaned, measured, and made quite ready for the market as it comes from the machine.

Small thrashing machine.—On the principle of Meikle's thrashing-mill, Mr William Johnson, an ingenious mechanic, of Langholm, in Dumfries-shire, has constructed a small thrashing machine, which is driven by manual labour, and with two men is stated to be capable of thrashing out 10 or 12 bushels of grain in the course of an hour. The expence of such a machine does not exceed L.8 or L.10; from which it seems well calculated for small farms, if, as some suppose, the moving power required be not too much for human exertion.

Sect. VIII. *Of the Hay-turner.*

A machine for turning hay has been invented by Mr Salmon, of Woburn, in Bedfordshire, which is said to be extremely useful for the purpose for which it is intended, as a man and a horse can do the work of 10 or 12 men in the ordinary way of performing this labour. The following is a description of this implement.

This machine consists of a number of rotative rakes, which are set in motion by one of the wheels which support the whole frame. These rakes are furnished with teeth, which, revolving with great rapidity, raise the hay as they come in contact with the surface of the field, and throw it backwards. The iron teeth are attached to the arms by means of a hinge, and they are kept in their place by the force of a spring, which, yielding to any pressure or obstacle, returns them to their place when the pressure is removed. The machine is so constructed, that longer or shorter teeth may be applied, or a part, or the whole, as the surface of the ground or the nature of the crop may require. This peculiarity of construction is convenient when the machine is moving on a road, or when it is unemployed; for, by turning the teeth inwards, there is no danger of accident to cattle or other animals approaching it. It is stated as another advantage, that the same machine may be made to act as a horse-rake for gathering the hay into windrows, or for raking up stubble.

Fig. 4. Plate 5. is a plan of this machine, somewhat differently constructed. AA are the shafts; BB the frame; CD the wheels, one of which, D, communicates the motion, by the toothed-wheel and pinion *ab*, to the axle EE of the rotative rakes; FFF the arms of the rakes.

Fig. 5. is the profile, or elevation of the same machine. A one of the shafts; B the frame; D the wheel, which puts in motion the rotative rake; *aa* the arms of the rake; *bb* the teeth; *cc* the springs, which return the teeth to their place when the obstacle or resistance is removed; E a third wheel or roller, turning on a centre bolt or pivot.

These machines are manufactured and sold by Messrs Wilson and Company, iron-founders and patent thrashing-machine makers at Leicester; and they are sold also by Messrs Cooke, Fisher, and Company, at their Repository, Winsley Street, Oxford Street, London.

Sect. IX. *Of Wheel-carriages.*

As a large proportion of agricultural labour is performed by means of wheel-carriages, it is of great importance that they should be so constructed as to be capable of accomplishing the purposes for which they are intended, with economy, facility, and despatch. The character of the draught animals, the nature of the work, and the condition of the roads, must, in some measure, affect the form and construction of the carriages employed; but these circumstances, it may be suspected, have often less influence in regulating the form and size of machines of this description, than the prevailing practice in particular districts. As an example of this, the heavy waggons, which are still extensively in use in many parts of England, have been adduced by writers on this subject; but, for the more ordinary purposes of husbandry, where the conveyance is short, carriages of a large size are by no means suitable. More time is required in loading and discharging, and more injury is done to the roads, than when carriages of a lighter construction are employed. The only case in which such carriages can be usefully preferred, and even here the advantage is doubtful, is, when a heavy load is to be conveyed to a great distance, through a level country, and over a good road.

Carriages of a smaller size, drawn by one or two horses, are justly supposed to be by far the most convenient for the purposes of husbandry, when the quantity of labour performed is taken into account, with the despatch which is thus obtained. Such are the carriages which are in general use in Scotland, and such, too, are preferred in some of the best cultivated districts of England; and perhaps the single horse cart, on every account, merits the preference; for it has been shewn, that the same number of horses, when employed in single carts, can draw almost a third more weight than when yoked together in the same waggon. A single horse, with one of these carts, properly constructed, draws from 12 to 24 Cwt., and, when the roads are good, even a heavier load. In the most improved cart of this description, the bottom, as it rests on the axle, projects over the inner heads of the naves, and approaches nearly to the spokes of the wheels. By this extension of the breadth, the capacity of the cart is increased, and the perpendicular position of the lateral standards enables them to sustain a much greater weight. The dimensions of such a cart are usually about five feet three inches in length, four feet in breadth below, four feet three inches above, and one foot three inches in depth. It contains about a cubic yard. The height of the wheels is usually about four feet two inches, and the axle is commonly made of iron. This is called the *close* cart; and what is denominated the *coup* cart, which is pretty common in many districts of Scotland, is so constructed, that the body turns on hinges, and falls down behind, so that the entire load can be at once discharged without unyoking the horse.

It has been justly observed by a practical writer, that single horse carts, which are in use in various parts of England, are the best calculated for every kind of carriage, except large masses of wood or stone, which cannot be conveniently divided into separate loads; and, as a proof of the economy of such carts, they are employed in almost all places where the roads are bad, either arising from soft mud and clay or large stones, and where there are deep ruts, especially in the mountainous districts both of England and Scotland. The same writer, the author of the Agricultural Report of Middlesex, after noticing the large and expensive teams which are indulged in, seemingly for parade and show, in a country which is level, the roads good, and the people rich, adds, that he employs four one-horse carts, each of which carries 25 cubical feet of the gravel of flints, and from 30 to 40 of manure. If farther proof were necessary of the superiority of single horse carts, a striking example is recorded of a carrier at Carlisle, who, after having many years employed a waggon, laid it aside, and now uses single horse carts only, because in this way, with the same number of horses, he can convey a much greater load.

Besides the advantages which single horse carts possess, of being loaded and unloaded with more ease and convenience, and of being more manageable for almost all purposes, the size of the wheels may be adapted, with the greatest exactness, to the height of the horse, and be placed more suitably to the centre of gravity of the load, by which the draught is greatly diminished. For as those parts of the neck and shoulder-blades, on which the collar rests in draught horses, have that degree of slope which forms an angle with the horizon of about 14° or 15°, it is obvious that the line of draught should form a similar angle, because in that case they pull in that line of direction which coincides most with the shape of the shoulders, and consequently the different parts of the shoulders are equally pressed upon; and hence it is, that horses draw more in a sloping than horizontal line of direction. The power or advantage which they have in overcoming the resistance of obstacles, in this direction, is likewise considerable. From these principles it is justly inferred, that single horse carts are far more advantageous than teams, because in the latter many of the horses draw in a horizontal direction, and consequently in a way that is inconsistent with their mechanism. From this consideration, too, it appears, that the wheels in every sort of cart should be properly adapted to the size of the horse or other animal which is employed.

In places where small carriages are in use, different kinds are frequently employed for different purposes. The close and coup cart, which has been described, is chiefly used for carrying out dung, compost, and such compact, heavy, or loose materials; but when bulky loads, such as corn in the straw, hay, &c. are to be conveyed, it is not unusual to have a frame-work, which is fitted for the same wheels, and this kind of carriage is called a corn or hay cart; but it has been stated, that the farmer's cart, as it is denominated in England, as well as most of the small sized carts, and all those of the larger kind, by having ladders attached to them at the ends and sides, is quite sufficient for every agricultural purpose, without the additional expense and trouble of such a number of different carriages.

Irish Car.—This kind of vehicle, which is very generally employed, not only in the business of husbandry, but for many other purposes, in Ireland, from its peculiar construction possesses numerous advantages. It is easily filled; it may be drawn over soft meadow, or ploughed lands, with less injury and inconvenience, and it passes through confined gateways with facility. As the length is but a few inches more than the breadth, it approaches nearly to a square form; the wheels, which are low and broad, are placed under the body of the carriage, and, from the cylindrical form of their rims, the resistance in the draught is supposed to be greatly diminished, by which a heavier load can be drawn.

According to the opinion of many intelligent agriculturists, the wheels of carriages which are employed in husbandry should not be of too large diameter, because low wheels are not only cheapest in their original construction but are also strongest and most durable. In determining the breadth of carriage-wheels, the preservation of the roads has been generally an object of consideration, and it has been suggested, that the rims of the wheels, even of single horse carts, should not be less than five inches broad; and the breadth should be increased in proportion to the load to be carried, and the number of horses required. The form of the rim has been also a subject of speculation. While some suppose that it ought to be conical, it is more generally recommended by others to be of a cylindrical construction.

Sect. X. *Of the Bruising-machine, Straw-cutter, &c.*

Bruising-machine.—Various machines have been invented for bruising grain, for the purpose of feeding horses and other animals; and from this practice great advantage is derived; for it appears that seven parts of the same grain, when bruised or split, are equal, if not superior, to 8 parts employed whole, in feeding animals. One of these machines is composed of two cast-metal rollers or cylinders, from 12 to 16 inches long, and from 6 to 9 inches in diameter, placed in a horizontal position, in one frame. When these cylinders are driven round, the circumference of each rolls upon that of the other, by which the grain passing between them, is bruised or crushed. The frame in which the cylinders revolve, is furnished with screw-bolts, so that they can be placed at a greater or less distance, as the grain is to be more or less bruised. Above, a hopper is placed for containing the grain, and from this it is conveyed by a suspended board to the cylinders. This machine is driven either by manual labour, or by the application of any other convenient power. Mr Pasmore of Doncaster, in Yorkshire, has invented a mill for this purpose, and for which he has obtained a patent. This machine, from the simplicity and durability of its construction, is recommended as not being liable to be put out of order, while its performance is such, that with exertion it will crush a bushel of malt in less than four minutes, and beans, oats, and barley in proportion.

Straw-cutter.—Machines, under the names of straw or chaff-cutters, are employed for the purpose of cutting straw and hay for feeding cattle. They are variously constructed. In some, a strong box, open above, is fixed on the top of a wooden frame, about

Arable land. 6 feet long, 2 feet 9 inches in height, and from 12 to 15 inches in breadth. In this box are placed two small wooden rollers, round which passes a piece of double canvass, and when the rollers are turned round by the motion of the cutting wheel, the straw, which is spread upon the canvass, is carried forward, according to the length at which it is to be cut. Sometimes the knives or cutters are fixed upon a wooden wheel, about four feet in diameter, and sometimes they are attached to the arms of a cast-metal wheel. In some of these machines there are three cutters, in some two, and in others only one. Sometimes the knives cut in a sloping direction outwards, and sometimes inwards to the centre, which is considered as the best mode of operation. A straw-cutter, invented by Mr Salmon, costs about twelve guineas.

A machine for the same purpose, invented by Mr Macdougal of Oxford street, London, is represented as possessing, in a superior degree, facility in working, so that much time is saved in labour; and it has another advantage, that if injured, through accident or carelessness, it can be easily repaired. Mr Pasmore, already mentioned, is the inventor of a patent machine for the same purpose, the different parts of which are so constructed and arranged, that it is not liable to be put out of order, or to be choaked or clogged; and it is obvious that its power of operation is considerable, when it is stated that it is capable of cutting a bushel of chaff in a minute.

The bone-mill is a useful piece of machinery, for the purpose of bruising or crushing bones, where such can be had in sufficient quantity, to be employed as manure. The construction of such mills is sufficiently simple, as they generally consist of toothed or indented rollers; but it is obvious that they must possess, at the same time, considerable strength and solidity.

The turnip or potatoe slicer is a valuable instrument for preparing these roots, as the food of some animals for which they are less proper in their entire form. A machine of this kind has been lately invented in Lancashire, and is considered a great acquisition to those who think this mode of preparing turnips and potatoes advantageous to their live stock. The roots to be cut are placed in a hopper on the upper part of the machine, from which they fall down upon the knife or cutter, which has a double edge, and is moved horizontally. The operation of the machine is stated to be so powerful that more than two Cwt. of potatoes can be sliced in a few minutes. The price of this machine is about L.7.

Chap. VI. Of Arable Land.

In forming any system for the management of arable land, various circumstances must come under the consideration of the husbandman,—as the preparation of the soil,—the kind of crops to be cultivated,—and the order in which these crops should succeed each other. The requisite preparation of land, for the reception of seed, is regulated by the nature and condition of the soil, whether it has been formerly under culture, or whether it be for the first time brought into an arable state; and the situation and peculiar character of the soil direct to the proper selection of the crops to be cultivated, as well as to the order of their succession. These topics may be conveniently discussed under the three following heads of tillage, kinds, and rotation of crops. Arable land.

Sect. I. *Of Tillage.*

Under the general denomination of tillage are included all those operations which are performed by the plough, the harrow, and other implements, and which are necessary in the preparation of the soil for the reception of seeds, and for promoting their vegetation and growth. For these purposes, lands which have been long under cultivation, and are in the best condition, require some preparation. This comprehends the ordinary operations of tillage; but in certain conditions of the soil, as when it becomes foul with weeds, extraordinary labour is requisite to restore it to the proper degree of cleanness; and in certain cases, when a different culture, or a nicer management of certain crops is adopted, as when they are raised in rows or drills, corresponding variations in the treatment and preparation of the soil must be pursued. This suggests the method of considering the operations of tillage under the heads of ordinary tillage, fallowing, and drill husbandry; but as it rarely happens that land which has never been in a state of cultivation is fit for the operation of the plough, it is necessary to attend to the means of removing those obstructions which, in a greater or less degree, exist in almost every soil.

1. *Obstructions to Tillage.*

The obstructions to the tillage of lands which have not been subjected to the plough, arise chiefly from inequalities of the surface,—from woody or shrubby plants covering it,—from stony masses in the soil,—and from an excess of moisture, proceeding from springs, or from collections of rain-water; and before any successful operation can be attempted, it is necessary that such obstructions be effectually removed. The means of removing the last obstruction have been fully treated of under the chapter on Draining; so that our attention is now to be confined to the consideration of the proper methods of preparing land encumbered with any of the former, and relieving it from such obstacles as either retard or altogether interrupt the necessary operations. It is scarcely necessary to add, that the more perfectly this preliminary work is completed at first, the greater is the saving of labour, and the ultimate advantage, in every step of the future management.

Wood.—Various methods must be adopted in clearing land from wood, according to the nature of the trees to be removed. Large trees of the timber kind must be grubbed up in the proper season of the year. Trees, such as the oak, whose roots penetrate deep in the earth, may be removed by clearing away the earth all round, cutting a few of the stronger lateral roots, and pulling by a rope from the top. But in such trees as have roots shooting laterally along the surface of the ground, these roots must be almost entirely removed before the removal of the tree can be accomplished. Trenching with the spade, and forcing up the roots with the pick-axe, are recommended by some writers as the most effectual means to be pursued in such cases; and by this management, although expensive, the obstructions are not only removed, but the land is advanced in its preparation for future operations. When the roots are of large size, and little decayed, blasting with gunpowder, for which a particular apparatus has been contrived, has frequently answered the purpose. The ashes produced by burning the brushwood, cut and collected on the surface along with the roots, may afford a quantity of useful manure as some compensation for the extraordinary expense. When the larger roots and most of the shrubby plants have been removed, previously to the first ploughing, the ground is sown with such crop as is adapted to the soil and situation; and after that crop is removed, the unfinished operations of clearing the land may be completed by repeated ploughings and harrowings, till the extirpation of every root and plant which obstructs tillage is effected; but when time or expence, or other circumstances admit of it, it is by far the preferable method to complete the clearing process before any crop is attempted to be raised.

In removing the roots of large trees, it has been thought that a good deal of injury is done to the ground by breaking it up and leaving large openings, and by mixing the rich surface-soil with the less fertile and sometimes hurtful under-soil. To remedy these inconveniencies, it has been recommended to allow the roots or stools of different kinds of plants, after their tops are cut off, to remain in the ground and undergo a spontaneous decay, while the larger roots may be taken up some time afterwards, and this with little disturbance of the under-soil, and their places filled up with stones and other useless materials from the surface. When the land is thickly covered with leaves, or other vegetable matters, they may be collected in heaps to decay naturally, or they may be burnt and the ashes spread over the soil. The surface, where it may be necessary, being levelled, and those places which are bare of vegetation, after being superficially harrowed, being sown with the suitable kinds of grass seeds, a second harrowing is given, and then a complete rolling of the whole to admit the scythe. After this preparation, such land is to be stocked with sheep; and, continuing the operations of the scythe when any woody shoots appear, it is to be kept in close pasturage till the smaller roots that were left shall yield to the plough, and then a succession of grain crops may commence.

A portion of lime, or some other calcareous matter, added to the vegetable materials, promotes their decomposition and decay, and produces a quantity of valuable manure, which, being spread on the surface, encourages the growth of the better kinds of herbage. This is more relished by the sheep, is eaten closer, and soon forms a finer sward. By proceeding in this way the expence is not very considerable, where there is a scarcity of fuel, more particularly when the large trees have been properly cut down, and the brushwood cut off a little below the surface. In some cases the larger roots and the stubs of the copse wood are more than sufficient to meet the expence of clearing and levelling the surface.

Shrubby plants.—In clearing land of various kinds of shrubby plants, advantage may be taken of changing the nature and texture of such soils as are peculiarly suitable to their growth. Thus, the different kinds of willows which affect moist places, have their growth interrupted by draining the land; and the improvement of a sandy or gravelly soil, which is favourable to the broom and the bramble, checks the luxuriance of plants of that description. For this purpose the application of clay marl, loamy earth, composts of peat and lime, or other manures, according to the nature of the soil and the object of the change to be effected, is to be regulated. But when such shrubs have attained a considerable size, the usual method is to cut them close to the ground, to dig round the roots, and to grub them up. The practice of burning furze before grubbing up should be avoided, on account of the loss of a large portion of vegetable matter on the surface.

It frequently happens, that lands which have been thickly overrun with brushwood, and particularly with furze and broom, are again infested with the same troublesome plants when under grass, from the seeds and small roots which lurk in the soil; it is recommended to keep such lands under tillage for a sufficient length of time, and, with the aid of lime and other suitable manures, the risk of their recurrence is greatly diminished. But if they are laid down with grass, and pastured with sheep, every shoot, as it appears above the surface, is destroyed, and the ground in a short time is entirely cleared.

Heath.—In preparing ground covered with heath for the operations of tillage, the heath, which is slow in its progress towards decomposition and decay, and affords but a scanty addition to the soil when it is converted to vegetable mould, may either be burnt down in the dry season of spring, particularly when it grows high and close, or it may be pared off with a thin slice of the surface, or cut down with a strong short scythe, collected into heaps and consumed by fire. In whatever way the heath has been removed, a large proportion of quick lime is recommended to be applied to the surface before ploughing, when its effects, according to some writers, are most visible in destroying the remaining roots of heath and coarse herbage, or it may be spread on the ploughed surface.

Paring and burning.—Analagous to one of the processes just mentioned for the reduction of heathy ground, to a state fit for tillage, is that of paring and burning certain lands with the same view. This subject has excited a good deal of diversity of opinion, and even some degree of controversial discussion both among practical and speculative writers; for, while some have extolled its advantages without proper discrimination, others, observing its injurious effects in particular cases, have greatly underrated its benefits when judiciously conducted. After all that has been said and written on the subject, there seems to be little difficulty in forming a correct judgment in what circumstances such a practice may prove beneficial. One of the objects of the process of paring and burning is, to prepare the surface of ground which is covered with shrubby plants and coarse herbage for the purpose of tillage. This object is fully

Arable land.

attained by such means. But this is to be regarded as only the mechanical part of the operation. It is necessary to consider the changes that take place in the combustion of a large proportion of vegetable and earthy matters,—whether something noxious be not removed from the soil, or whether something under a new form be not added to it, which is salutary in promoting healthy vegetation. The earthy matters in the soil exposed to burning, undergo no farther change than being deprived of their moisture, from which probably arises a considerable difference in their texture or consistence; but the whole of the organized matters, which are chiefly of a vegetable nature, are decomposed, their volatile parts are driven off, and the more fixed ingredients only remain. Some of the products of the combustion, although small in quantity, are of a very active quality, and, mixed with the soil, contribute very essentially to its improvement.

As no soil is fertile which is destitute of animal or vegetable matter, it is obvious that any process by which it is deprived of the necessary proportion of that matter must be injurious, in producing sterility. But the destruction of a large proportion of the organised substances in the soil, is the certain consequence of the process of combustion. If, then, it appear that the quantity of vegetable matter is deficient, paring and burning, by which the deficiency becomes greater, ought to be avoided. "All soils, (says Sir Humphry Davy,) that contain too much dead vegetable fibre, and which, consequently, lose from one-third to one-half of their weight by incineration, and all such as contain their earthy constituents in an impalpable state of division, that is, the stiff clays and marls, are improved by burning; but in coarse sands, or rich soils, containing a just mixture of the earths, and in all cases in which the texture is already sufficiently loose, or the organizable matter sufficiently soluble, the process of burning cannot be useful. All poor siliceous sands must be injured by it; and the operation is never performed by good agriculturists upon siliceous sandy soils after they have once been brought into a state of cultivation." The soils adapted for paring and burning are such as contain a redundancy of vegetable matter, some of which, by the process of combustion, is brought into an active state, and serves as a valuable manure in promoting the decomposition of the remaining organised substances, and thus enriches and improves the natural soil, by rendering it less compact, less adhesive, and less retentive of moisture.

It may perhaps be useful to the chemical agriculturist to know the nature of the products obtained by paring and burning; and this may lead to some conclusions with regard to the effects of the process. Specimens of ashes from different soils were examined by Sir Humphry Davy. Two hundred grains, from a chalk soil in Kent, afforded

80 Carbonate of lime.
11 Gypsum.
9 Charcoal.
15 Oxide of iron.
3 Saline matter, sulphate of potash, muriate of magnesia, with a minute portion of potash.

The remainder consisted of alumina and siliceous earth. Some of the ingredients in this specimen of ashes are very active manures. The charcoal was in a state of minute division, and the gypsum and oxide of iron are supposed to produce very powerful effects on soils which contain an excess of carbonate of lime.

The second specimen of ashes was the product of a soil from Leicestershire, in which only four per cent. of carbonate of lime appeared; the quantity of the other earths amounted to three-fourths of light siliceous sand, and about one-fourth of clay. One hundred parts of the ashes yielded

6 Charcoal.
3 Common salt and sulphate of potash, with a trace of potash.
9 Oxide of iron.

The third specimen was from a stiff clay from Cornwall; the land was brought into cultivation from a heath, by burning, ten years before, but having been neglected, the furze plants were springing in different parts of it, so that it required a second paring and burning. One hundred parts of the ashes gave

8 Parts charcoal.
2 Saline matter, chiefly common salt, with a little potash.
7 Oxide of iron.
2 Carbonate of lime.

The remainder of this specimen consisted of alumina and siliceous earth. It is observed, that the quantity of charcoal was greater than in the other cases. The portion of common salt in the ashes of this soil is ascribed to the vicinity of the sea, which is only two miles distant; but common salt was also found in the specimen of ashes from Leicestershire. In the land from which the last specimen of ashes was obtained, there was an excess of dead vegetable fibre, as well as a portion of unprofitable living vegetable matter; and a very essential improvement was the consequence of the burning. In the speculations concerning paring and burning, attempts have been made to explain the effects, by referring to causes of a very obscure nature. Some suppose that clay, during the burning, absorbs nutritive principles from the atmosphere which may be afterwards supplied to plants. According to another writer, carbonic acid, which, in its combination with iron, is injurious to plants, is expelled during the operation of burning. But the whole immediate effects seem more properly to be referred to the diminution of the coherence and tenacity of clay soils, and to the destruction of inert and useless vegetable matter, and the conversion of the ingredients of which it is composed into an active manure.

Lands fit for paring and burning.—All lands which are overrun with furze, broom, brambles, and coarse herbage of any kind, and which have not been before reclaimed from a state of waste, are brought into a state of cultivation, with expedition and certainty, by the process of paring and burning. The same method is successfully practised on boggy, moory, and peaty soils; on mosses containing calcareous matter, either in the soil or subsoil, or a considerable proportion of clay; or such as have been top-dressed with clay; or on a shallow mossy soil, resting on a clay subsoil. An experiment by Mr Young, on a cold, wet, poor loam, with a clay-marl bottom, shews the remarkable effects of paring and burning. An old grass field, of $4\frac{1}{2}$ acres, was the subject of the experiment. Four acres were ploughed four inches deep, which was the whole depth of the soil. Four heaps were formed in the field, and, from particular circumstances, the calcination was supposed to be carried too far, but the ashes were spread and ploughed in with a shallow furrow; turnip seed was sown, and slightly bush-harrowed; the crop was luxuriant, and the produce on the burnt part was double of that on the half acre which was not pared. At the end of three years, when the whole field was in grass, the burnt part of the soil, if any difference existed, appeared the best.

The practice of paring and burning is common on chalky soils in different parts of England, as, on the Cotteswold hills in Gloucestershire, in the sheep-walks and warrens on the Wolds in the East Riding of Yorkshire, in Hampshire and Wiltshire; and in the West Riding of Yorkshire, limestone lands, with only four inches depth of soil have been pared and burnt for ages, without any appearance of that waste or destruction to the soil, which is apprehended by those who think unfavourably of this practice. The same process has been found equally beneficial in Kent, where a great extent of land produces abundant crops of wheat, barley, and oats, after being several times subjected to it. Paring and burning are particularly recommended as the best method of breaking up old, worn out, sainfoin leys; for if the plough be merely had recourse to, the red worm, which is often abundant in leys of this description, is exceedingly destructive to the corn crop. Paring and burning for turnips is considered the safest and most successful husbandry in such cases.

Operation of paring.—Different instruments have been employed for separating the sward from the surface of the soil. When the sod is pared off, the instrument in use in most districts, is the breast spade, or breast plough, or what is called in Scotland the *flaughter* spade. The thickness of the sod cut off is about an inch, or $1\frac{1}{2}$ inch, about one foot broad, and three in length. When the operation is conducted on a large scale, as in the fenny districts on the eastern coast of England, the horse paring plough, which is differently constructed, but varying chiefly in the breadth and sharpness of the share or sock, is an implement well calculated for paring off the sward of level grounds, and such as are free from stones. In the fenny and peaty lands of Cambridgeshire, which are free from stones and large roots, the paring is economically and effectually performed by a particular plough, which turns off a furrow from 12 to 16 and 18 inches in breadth, with little more than an inch in depth; but in some of the western counties, the common plough is used when the sward of old grass fields is to be pared. They are rib or slob furrowed about the beginning of winter; are again cross ploughed the succeeding spring, and the sods are collected and burnt. When the plough is employed in this way, a wing turned up on the furrow-side of the share is added, by which the breadth of the furrow is regulated. Another method, which is practised in Devonshire and Cornwall, for breaking up grass lands, and distinguished by the name of *skirting*, is performed by leaving part of the sward or surface alternately unturned, and upon this the next thin furrow slice is laid, so that the swards of each are brought into contact, by which means the decomposition of the vegetable matter is promoted, and what remains, after cross ploughing and harrowing, is separated from the soil, collected into small heaps, and burnt. This operation is called *beat burning*.

Depth of soil pared.—The nature and thickness of the soil must, in a great measure, regulate the depth or thickness of turf to be separated. A light thin soil ought not to be pared so deep as a stiff heavy soil, covered with a close mat of vegetable matter. The usual depth of paring is from one to three or more inches, while some, who are zealous advocates for this practice, take off turfs, even from thin chalky lands, as thick as the nature of the soil admits, and assert, that the thicker they are the better, if they contain a sufficient quantity of vegetable substance to make them burn well.

Burning.—The operation of burning is differently conducted in different districts. According to some writers, stiff and clayey soils would derive considerable advantage from the fire being brought into contact with the whole surface, while, in soils which are thin and light, the sward pared off is collected and piled up in heaps, to undergo combustion, without permitting the fire to act upon the mould over the whole surface. If the first method be adopted, the sods must be collected into very small heaps, so that they may be burnt upon as great an extent of surface as possible; but, according to the other method, they are formed into small circular heaps, the sods being placed with the grass side downwards, for the admission of air. But, as soon as the combustion has fully commenced, the openings both at the bottom and top should be closed up, that it may proceed in a slow, smothering manner, and the heaps are allowed to extinguish themselves. In paring heaths, downs, moors, and old sainfoin leys, it is recommended that the heaps should not be larger than to yield from 12 to 15 bushels of ashes, otherwise the turfs are apt to be too much burnt; but when the weather is unfavourable, the heaps should be increased in size, to promote the combustion. It should be observed also, that thin sods burn in smaller heaps than those of greater thickness.

If the season be not very wet, the sods are sufficiently dry for burning in about a fortnight or three weeks; but in rainy weather a longer time is required, and they must be turned more than once, to prevent the roots and shoots from striking out, by which the combustion would be interrupted.

When the process of burning is fully completed, and the whole is reduced to the state of ashes and earthy matter, it should be spread on the land as soon as possible, and in as regular and equal a manner as can be effected; and the application of the ashes to the soil should always be made before rain falls, otherwise the saline portion of the ingredients is carried off, and its beneficial effects are lost. It is recommended also, to secure the full influence of the ashes, to give the land a slight ploughing immediately after they are spread.

Season for paring and burning.—Dry weather, it is obvious, is most favourable for this operation. It is most extensively practised in the months of April, May, and June; but the particular period is oftener regulated by the state of the weather, and the nature of the crop which is to follow. In the northern districts, the end of May, or the beginning of June is considered a very convenient season, when green vegetable products are in their most succulent state; but in the southern counties, an earlier period is fixed upon, or the interval between the hay and harvest time is chosen, if the land to be improved be not of great extent. If a large tract of land is to be improved by this operation, the autumn may be the most convenient season for performing it. When barley or oats is to be sown after paring and burning, it is necessary to have the process completed as early in the spring as the weather will admit; but if the crop intended be rape or turnips, the end of May, or the beginning of June, is a proper time; and when it is proposed as a preparation for wheat, the month of July, or the beginning of August, may, in a good season, answer the purpose.

Stones.—Stones which are either in a loose state, or fixed in the soil, form serious obstructions to the cultivation of land. Deep and alluvial soils rarely contain large masses of concealed stones; and, if smaller stones should appear on the surface after harrowing, and particularly when the land is to be laid down with grass to be cut for hay, they should be picked off by the hand, before the application of the roller, or they may be forced into the soil by means of heavy rolling; but when the stones are collected, they should not be thrown into heaps in the furrows, but completely removed, otherwise they may be again dispersed over the ground. This work can be most conveniently and effectually done when the land is under summer tillage. When the soil is wet, the stones may be collected into heaps, and removed during the first opportunity of a dry season. The removal of small stones from certain lands, has been supposed to be injurious to the crop, from depriving the plants of shelter in the early stages of their growth, or from some change in the power of absorbing or giving out heat or moisture; but perhaps a closer investigation would discover that the diminution of fertility might be traced to some other cause.

When the stones are of a large size, and fixed firm in the ground, or are *sit-fasts*, as they are called in some districts, and when they appear above the surface, it is recommended as the best practice, to dig them completely out of the earth, after they have been blown to pieces by means of gunpowder. This latter expence may be saved when they are of smaller size, by digging round, splitting them with wedges, or breaking them with large hammers. Stones are sometimes removed from the surface, by sinking large pits, but as the stone is entirely lost, and the business cannot be conducted without danger to the workmen, this method should only be had recourse to when others are impracticable.

When the stones are concealed below the surface, their situation must be discovered, either by forcing a sharp instrument into the ground, or by marking the spot where the plough is obstructed; but if the stones are very numerous, and the price of labour low, the use of the spade, in preference to the plough, is recommended as the most economical method of preparing such land. In whatever way the land is cleared, the whole business should be completed before the operations of tillage commence, because the loss by the destruction of the implements, and the unavoidable delay from such obstructions, more than counter-balance the necessary labour and expence in removing them.

The expence of clearing land from stones may be diminished by applying them to various useful purposes, as in the construction and filling up of hollow drains, or in building walls for fences, or some of the farm-offices; and it has been stated, that in situations where any useful application can be made of large surface stones, the most rugged lands may be profitably reclaimed.

In preparing land for the operation of the plough, it is scarcely necessary to add, that the surface should in all other respects be so adjusted, by filling up hollow places, and reducing every kind of inequality, that it shall meet with no obstruction in its progress. In some cases, advantage may be taken of the stones, or other useless and rugged materials, by collecting and throwing them into hollow spots, and covering them to a sufficient depth with good soil.

Sect. II. *Ordinary Tillage.*

After the obstructions which have been noticed are removed, the soil is turned up and loosened for the reception of the seed. But before the operation of the plough, which is the implement in universal use for this purpose, is admitted, it is of no small importance to consider the soil, the season of the year, and the nature of the crop proposed. It is a prevalent opinion, that there are few soils which are not improved by ploughing about the end of autumn or beginning of winter; because it is supposed they absorb and retain a large proportion of moisture for the approaching summer; but when they are turned up in the spring or summer months, the rapid evaporation which follows occasions an excessive waste of moisture, and renders the land too dry. It is supposed, too, that the soil exposed during the winter season becomes mellow, as it is expressed, and derives some beneficial influence from the atmosphere. But before any decided opinion can be formed of the advantages of this practice, it would be necessary to inquire what is precisely understood by *mellowing* of the soil, and *atmospherical influence*, phrases which are in frequent use among agricultural writers—what are the changes which are thus induced,—what is absorbed by the soil,—and what is extracted from it during this exposure. The exposure of the water, by freezing in winter, tends to reduce stiff adhesive soils to a friable state; and this, although somewhat of a mechanical nature, is undoubtedly a considerable benefit.

The peculiar condition of the soil ought also to be considered before any operation of tillage is attempted. No land, of whatever description, should be ploughed when it is loaded with wetness. Tenacious soils when subjected to the operation of the plough in such a condition, are apt to cake and run together in lumps, which it is afterwards difficult to reduce and pulverize; and besides the additional labour which is necessary, the ground is greatly injured by *poaching*, or the treading of the feet of the cattle. Marshy or mossy soils which have been brought into cultivation, can rarely admit the plough when in a wet state; so that such soils can only be advantageously wrought during dry weather. An intermediate condition of the soil, which is neither too wet nor too dry, which is neither so tenacious as to adhere to the horses feet, or to the implements employed in the tillage processes, nor so friable as to fall into the state of loose earth when it is turned up, is the most suitable for the successful and perfect operation of the plough. But when the nature of the crop requires it. the precise regulations of times and seasons cannot be always rigidly observed.

Operation of ploughing.—By the peculiar construction of the plough, which has the mould-board on the right side, the mass of soil, or the furrow-slice, is turned over during its operation to the same side. In this description, which refers to the plough drawn by two horses, the horse on the right side, or the off-side horse, walks in the furrow, or the space which is left vacant by the removal of the former plit. The near-side horse, or the horse on the left hand, walks on the fast land, and the ploughman walks in the new furrow, or the space which is left by the furrow-slice just formed. In careful ploughing, no part of the land should be left unturned up, and the furrow-slice should not be permitted to fall back into the furrow, which sometimes happens when the breadth of the slice is too great, or when the left handle of the plough is too much depressed. To prevent this, the ploughman who is attentive to perform his work neatly, walks with his left foot only in the furrow, while he presses down with the right foot the newly formed furrow-slice. This management is peculiarly requisite in ploughing old leys, and especially in striking the ridges.

Breadth of the furrow-slice, &c.—The breadth, as well as the depth of the furrow slice, is regulated at pleasure, by varying the draught on the bridle of the plough. When a broad slice is wanted, the line of draught of the plough is directed to the left or land side, and when a greater depth is required the plough goes deeper; but the regulation of the plough is so managed, that if merely kept in its working position, it cuts a little broader and deeper than what is wished. The coulter also has a slight inclination towards the left side, and the point of the sock is somewhat directed downwards. This arrangement of the different parts is called in Scotland the *tempering* or *setting* of the irons. The dexterity of the ploughman consists in making his horses move in a straight line, and in keeping the plough in the same uniform direction. Artful ploughmen, to save themselves attention and labour in performing their work, give the plough too great a tendency to dip into the ground, and this they counteract by pressing with their own weight on the handles, at the expence of unnecessary additional labour to the horses.

The furrow slice is turned over to a greater or less degree, according to the proportion between the breadth and depth. When the breadth and depth are nearly equal, the furrow-slice turns over at an angle of about 45°; and a field ploughed in this manner presents the appearance of angular drills or ridgelets. When the breadth of the slice much exceeds the depth, it is almost entirely turned over, with its former surface downwards, and each successive slice somewhat overlaps the preceding; but when the depth is much greater than the breadth, the slice falls over on its side, and is somewhat overlapped by the next, leaving the original surface bare, and slightly inclining to the horizon. The nature and condition of the land determine the preference to be given to each of these modes of ploughing. The square slice is considered best adapted for laying up stubble land after harvest, to be exposed during the winter, as a preparation for fallow or turnips. The shallow slice, with considerable breadth, is convenient for breaking up old leys, because it covers up the grass turf, and the fertile soil is not buried too deep. The method of ploughing, by making the depth exceed the breadth of the furrow-slice, is not approved of.

In determining the depth of the furrow in ploughing land, the quality of the soil, and the kind of crop to be cultivated, are to be considered. Some shallow soils, which are extremely fertile, rest on a subsoil which is injurious to vegetation. In such cases, deep ploughing would be highly improper; but, on the other hand, when the subsoil contains ingredients, such as calcareous or vegetable matter, which serve to increase the fertility of the soil, it may be useful to the crop to have a portion of it occasionally turned up by the plough. Mr Young recommends that one deep ploughing, when the soil admits of it, should be given in the course of 12, 18, or 24 months; and when this is completed, shallow tillage, by the operation of implements which merely stir the surface, is a better practice than working deeper; but, in general, for ordinary corn and grass crops, no great depth of furrow is required; nor is deep ploughing necessary even for cleaning land; since it is found that a clean, shallow ploughing, or hand-hoeing, is the most effectual method of destroying weeds. From four to six or eight inches may be considered as a sufficient depth of furrow in ordinary cases.

For certain crops, such as carrots, a deep ploughing is requisite. In soils which admit this kind of crop, what is called *trench*-ploughing, is practised. This is executed by means of two ploughs, which follow each other in the same furrow; and the second plough throws its furrow-slice on the top of the first. The first plough goes to the depth of seven or eight inches, and the second increases the depth four or five inches more, so that a furrow of 12 or 13 inches deep is formed in this way. According to the views of some agriculturists, deep ploughing is beneficial, by bringing up a portion of fresh soil, which promotes the growth and increases the quantity of different crops, such as clover, turnips, beans, and potatoes. It is also considered as of no small importance in obviating the effects of too wet or too dry a season. The ground is more effectually cleared of weeds by the same means; animal and vege-

Arable land.

table manures are supposed to be more useful by being well covered up, and the staple of the soil is increased, so that the roots of the crop are less liable to be injured by wetness, and can resist longer the effects of drought.

Ridges.—In ploughing a field, the furrow-slices are arranged into beds of different breadths, which are denominated ridges, or lands, and they are divided from each other by open furrows. By this arrangement, the future operations, as the regular application of manure, the equal distribution of the seed, and the cutting down of the crop, are conducted with greater facility and uniformity. The furrows which form the divisions of the ridges are necessary, in strong and retentive soils, for carrying off surface water; and hence they are sometimes called *water-furrows.*

Direction of the ridges.—As far as the situation of a field admits of it, the direction of ridges should be north and south. Deviations from this position, for the purpose of draining the land, or on account of the particular form of the inclosure, may be often necessary; but it seems always advantageous to bring the course of the ridges as nearly in this direction as possible; for it appears, that in ridges which have an east and west direction, even when the elevation is not considerable, the crop on the south side has ripened a week earlier than that on the north; and at the time of reaping, the wheat has been observed too ripe on the south side, while, in many spots, it was green on the north. On ridges which have a north and south direction, the ripening and drying of the grain, after it is cut down, are more uniformly accomplished, because the shocks are more fully exposed to the influence of the sun and wind.

Breadth of the ridges.—Great diversity of opinion and practice prevails with regard to the breadth of ridges; and it has been observed that the breadth and flatness of ridges should be increased, as the soil is more of a light sandy quality; while, on the other hand, they should be narrower, higher, and of a more rounded form, on a stiff clay soil, that the redundant water may be freely discharged. In loamy soils, the ridges are recommended to be broad and flat, or narrow and round, according as they approach to the sandy or clayey soils. Broad ridges, or even, in some cases, altogether flat, without any furrow, are formed on soils of a sandy nature, that the moisture, which is apt to pass off too rapidly, may be more effectually retained.

In wet, clayey, or stiff and adhesive loamy soils, with a sub-soil of clay, narrow ridges are recommended, to preserve the crop from excessive moisture. In such soils, a ridge of three or four feet is considered fully sufficient; and in Essex, a ridge of three feet in breadth is found to answer the purpose effectually, and is preferred to ridges of greater breadth, for allowing the water to pass off without washing the land. In some of the best cultivated districts of Scotland, the ordinary breadth of ridges is 15 or 18 feet. On thin clays, with a retentive bottom, some agriculturists prefer a ridge of nine feet, as most convenient for removing the excess of moisture; while others think that a ridge of 18 feet carries off the water as effectually as the narrow ridges which are adopted in some parts of England. On dry turnip soils, with an open sub-soil, the land is formed into ridges of double the breadth, as 30 or 36 feet; and in completing the tillage operations on a soil of this description, especially before it is laid down for grass, it is usual to cut up a narrow ridgelet, or single-bout drill, between the broad ridges, to direct the process of sowing; and when the seed is covered in by the harrow, all the ridgelets are nearly destroyed, so that the field presents a smooth, uniform surface.

Arable land.

Forming ridges.—When a field is to be formed into ridges, the ploughman to whom this work is entrusted is furnished with three or more poles, shod with iron, and each $7\frac{1}{2}$ feet long, when the breadth of the ridges is determined to be 15 feet. The head ridges, on which the horses and plough are turned, are first formed, and a breadth of 18 feet is the least to afford convenient space for this purpose. The intended breadth of the head land is measured off with the poles, at right angles to the boundary of that end of the field, or at right angles to a straight furrow drawn by the plough, when the boundary itself is irregular. The breadth of one head ridge being measured off, and three poles at least set up in a straight line, a furrow is drawn in the line of the poles, from one side of the field to the other, and the plough is returned in the same furrow to correct any inequality. The limits of the other head-ridges are laid off in the same way. One straight side of the field being assumed as the direction in which the ridges are to run, the ploughman measures off one length of a pole from that side, either at the top or bottom of the field; and at right angles to this straight side he sets up one of the poles at the point where the plough is to enter; a second pole is fixed in the same manner, at such a distance in advance as to be distinctly seen, and a third at the intended termination of the ridge. All the three poles are in one straight line; and sometimes, from the great length or inequalities of the field, a greater number than three poles is required. The plough is entered at the first pole, and the line of poles being kept precisely between the horses, the furrow-slice is formed; and when the first pole is ploughed down, the horses are halted, and two lengths of the pole are measured off for the middle of the second ridge. When the second pole is ploughed down, two lengths are measured off in the same way; and the plough having reached the extremity of the field, the last pole is set up in the same line with the two former, and all the three poles are in the line of the crown of the second ridge. To insure the correct execution of these operations, it is necessary to draw three cross furrows at right angles, otherwise there is some danger that the breadth of the ridge may not be exactly the same at the different extremities. This operation is called *striking furrows* in England, and *feiring* in Scotland.

After the first furrow-slice is formed through the length of the field, some ploughmen return in the same track, and throw a furrow on the other side, that there may be no firm land left below, and then the two sides are thrown back to form the crown of the ridge. But it is more usual to turn the plough short to the right, and to draw a second slice directly to meet or overlap the first, while any inequalities which have been occasioned by the irregular motion of the horses, in drawing the first slice, are corrected. The ploughman next proceeds to the second line of poles, and repeats the same series of operations till the whole field is worked off. When other ploughmen are employed, they fall in successively as the first has marked out the proper spaces, and all the slices are turned inwards or towards the crown of the ridge.

Another method, which answers less dexterous ploughmen, is sometimes practised for the purpose of marking off ridges. A strong pole, whose length is exactly equal to the breadth of the intended ridge, is attached to the plough at right angles to the line of draught. One end is placed across the stilts, exactly opposite to the coulter, when the other end projects towards the left hand of the ploughman, and is retained in its place by means of a rope, extending from the outer extremity of the pole to the collar of the near-side horse. A coulter, or harrow-tooth, is fixed in a perpendicular position, at the outer end of the pole, and as the plough moves forward, it makes a mark on the ground, parallel to the line of draught. By this contrivance, while the plough is going along the crown of one ridge, the marker traces the line upon which the furrow of the next ridge is to be drawn.

In consequence of inequalities in different parts of the same field, it is sometimes necessary to change the direction of the ridges, for the convenience of discharging surface water. When such deviations are required, an oblique furrow, either quite straight or waving, is drawn at the place where the change of direction is made; and at this oblique furrow all the ridges of the original direction terminate, and from it a new series of ridges commences, which is marked off in the same way as if it were a new field. The new oblique furrow is either made the crown of a ridge or a water-furrow, according to circumstances; and the oblique ridges thus formed are denominated *butts*.

Steep land.—In ploughing steep land, the ridges should be drawn in an easy sloping direction, that the water may be allowed to pass off in a gradual manner. In this way, there is not only advantage in the economy of labour, but the injury and inconvenience of heavy rains washing down the soil are in a great measure obviated. In such cases, the ridges of steep lands are neither to be formed parallel to the declivity, nor at right angles, but in a diagonal direction, in which the slope shall be such that the furrow-slice falls easily away from the mould-board, both in ascending and descending the field. This mode of directing the ridges on steep land, has another advantage,—that cross ploughing, when such is required, is readily accomplished by reversing the diagonal. When extremely steep land is brought under tillage, the ploughing must be conducted directly across the hill, and all the furrow-slices are turned downwards. When this work is performed with the ordinary plough, it must be carried back empty in the open furrow; but time may be saved and a great waste of labour avoided, by employing a turn-wrest plough, in which the mould-board shifts to either side. In ploughing a hill of a conical form, it is recommended to begin at the bottom, and, with the left hand always to the hill, to go round in a spiral direction. By this method of proceeding, any number of ploughs may work at the same time, with this precaution, that the lowest, which enters first, shall always keep in advance, all the rest succeeding each other in regular order.

Different kinds of ridges.—Various methods are practised in forming ridges. On dry soils, the furrow-slices of each ridge are all turned in the same direction, while those of the contiguous ridges are laid the contrary way. This is called *casting*. Sometimes the ridges are split out, so that the crown of the old ridge becomes the furrow of the new one. This method of ploughing is denominated *ridge* and *furrow*, and in Scotland *crown* and *fur*. On all strong soils the ridges are necessarily formed by twice gathering all the furrow-slices inwards, in the direction of the crown; and in this case the ridges and furrows retain their original situation; but when these double gathered ridges are broken up for summer fallow, it is usual to split or cleave them down, by reversing the former operation, and turning all the furrow-slices outwards, beginning at the furrows and ending at the crowns. In this way the ridges are reduced to half of their original breadth. The practice of ribbing, or rice-baulking, which is now rarely followed, was a kind of half-ploughing, in which the land intended for barley the succeeding year was thrown up after harvest into one bout of ridgelets or drills, a slip of fast-land being left unploughed between the furrow-slices, which were turned over to cover it.

Crown ridges.—Broad, high, and irregular ridges, which were at one time common, are now rarely met with, where improved cultivation has been adopted, excepting in stiff, wet soils, with a retentive sub-soil. On soils of this description, and in thin, weak clays, some danger may probably arise from reducing high crooked ridges to straight lands of moderate breadth and height; but in all fertile soils of sufficient depth, no doubt can be entertained of the convenience and profit to be derived from such improvement. The elevated crown, unequal breadth, and crooked direction of ridges, which formerly prevailed in some of the most fertile and populous districts of the country, seem to have had their origin, according to Mr Donaldson, in the manner in which lands were cultivated in the open field or run-ridge state. The small portion of land held by each tenant, precluded any attempt at proper draining; the furrows, which were the boundaries of each possession, were also the drains for carrying off the water, and the ridges were raised high in the middle, to secure the crop from wetness. The ridges are observed to be broader at one extremity than at the other. The narrowest end is usually the wettest; and it is supposed that the breadth was purposely diminished, that the furrows, the only drains which existed, might have the greater effect in drying the land. As the most crooked ridges are on the steepest and most sloping grounds, the same writer presumes, that this deviation from a straight course was adopted to prevent the soil from being washed down in heavy rains. But the original formation of the ancient crooked ridges, which are observed to have the curvatures at the extremities invariably reversed, is accounted for in a different way by others. As the old plough was itself of great length, and as it was drawn by three or four pairs of oxen, and even at this day, in some parts of England, by six horses following each other in a line; if the ridges had been drawn in a straight direction through their whole length, the unwieldy implement, and the numerous team, could only be turned on a very broad head ridge. To obviate this difficulty, the team moved in a curved direction at both ends of the ridge, that the plough might be drawn out on a head ridge of moderate dimensions; and as the ridges were gathered into high crowns, sometimes to a great height, the inclination to the left and the turning to the right, after the plough was drawn obliquely out on the head-ridge, answered the ploughman's purpose much better than if the deflection had been to the right, in which case it would have been necessary to drag back the plough to make it enter at the proper place, —a task to which the strength of one individual was altogether unequal, especially with the heavy and cumbersome implements then in use.

Levelling ridges.—The operation of bringing elevated, curved, and unequal ridges into a more level, regular, and straighter form, is attended with some difficulty. When this work is performed by the plough, the best time for executing it is when the land is under summer fallow, and is then subject to a course of repeated ploughings. When the elevation of the ridges is not very great, they are readily brought into proper form, by splitting or cleaving them down in the middle. The plough enters at the old furrows, and terminates at the crown of the former ridge; so that the former furrows become the crowns of the new ridges, and the new furrows are drawn in the middle of the old ridges. In open, light, or gravelly soils, the plough may be successfully employed in levelling the ridges, without any bad effects to the future crop; although, in soils of this nature, as well as in every other, the precaution of avoiding the risk of turning up too much of the sub-soil, when it contains useless or hurtful ingredients, should be strictly observed.

To preserve the vegetable surface-mould, and to avoid the injury that may arise from bringing up any of the under-soil, the following method of levelling ridges, by means of the spade, is recommended by Dr Anderson: A furrow is drawn with a plough across the ridges of the whole field to be levelled. This furrow is divided into as many parts as there are workmen; and each having a ridge or two allotted to him, as soon as the plough passes his division, begins to dig in the bottom of the furrow which the plough has just made, about the middle of the old ridge, and keeping his face to the old furrow, works backwards till he come to the middle of the old ridge, and goes deeper as he proceeds, according to the height of the ridge to be reduced. Turning towards the other furrow, he repeats the same operation on the other side of the ridge, so that the bottom of the trench thus formed may be as nearly level as can be conveniently made. That part of the furrow allotted to him, which is made by the plough in going, being finished, he proceeds to finish in the same way his own portion of the furrow which is formed by the returning plough. In levelling ridges in this way, it ought to be recollected, that allowance should be made for the subsidence of the loose earth, and therefore the old furrows ought to be raised higher than the middle of the old ridges. These temporary, or cross ridges, are recommended to be made forty or fifty yards broad; for although some time is lost in turning at the ends of the broad ridges, the advantage of few open furrows overbalances this loss; and, to keep down the height in the middle of each of these great ridges, it may be proper to draw the furrow which is to be the middle of each some time before the operation of levelling with the spade commences, that all confusion or loss of labour may be prevented. This breadth of ridge is convenient where the land is in a sufficiently dry condition; but in wet stiff soils it must be greatly diminished. From a comparative estimate of the expense of levelling by the spade and by the plough, it appears that it can be accomplished at one-fourth of the expense by the former method.

Another method of levelling ridges is described in the Report of the State of Agriculture in the county of Perth. The good soil on the crown of the ridge is removed to one side by two or three ploughings in the same direction, and turning the furrow always the same way. A sufficient quantity of the buried soil is then thrown with the spade from the crown of the ridge to fill up the old furrows, and the good soil is equally spread over the whole surface. Should it be thought necessary to save the soil over the whole ridge, one side may be taken first, and then the same operation may be repeated on the other. A summer fallow, with a copious application of lime to the new soil, completely restores its powers of fertility. For the purpose of levelling the uneven surface of land, a machine which, it is said, effectually answers the purpose, has been invented by Mr Charles of West-Mead, Langhorne, in Carmarthenshire, a description of which is given in the 21st Volume of the Transactions of the Society of Arts. Whatever method is followed, it is of no small importance to have the ground reduced at once to that degree of smoothness of surface which renders every future tillage operation convenient and efficient. But in lands whose surface has been so much changed, its firmness is for some time very unequal. It may be therefore necessary to lay it into narrow ridges for some years after such operations, and to keep the furrows quite clear, to prevent the stagnation of the water among the loose earth with which the old furrows were filled. *Two bout* ridges, as they are denominated, when the condition of the soil and the situation of the land admits of their formation, are the most suitable for this purpose.

Extent ploughed in a day.—As agricultural labour of every description in which men and horses are employed, is always attended with a heavy expense, it is then of consequence to be able to determine the quantity of work which can be performed, without imposing too severe a task on the labourers, but particularly without oppressing the horses by excessive exertion. In ploughing, the quantity of land which can be turned up in a day, with one man and a pair of horses, and with the improved implement which is generally used in Scotland, must depend on the tenacity and condition of the soil,—the breadth and depth of the furrow-slice,—and the strength and vigour of the horses. In Scotland, to which the estimate now made refers, the period of a day's work on heavy soils extends to about nine hours—five hours in the morning and four in the evening, with an interval of two hours for rest; but when the soil is of a lighter nature, the horses are wrought ten hours. An English statute acre is 220 yards long and 22 yards broad; and if the acre be ploughed in regular slices of nine inches each in breadth, it will be divided into 88 furrow-slices, of 220 yards each in length, so that the whole series of slices extends to 19,360 yards; and if 12 yards be added to each of these slices for the ground travelled over by the plough in turning, the whole work of one acre extends to 20,416 yards, or 11 miles and nearly five furlongs. In the stiffest lands where ploughing is admissible, and the chief obstructions to tillage have been removed, a pair of strong horses, in good condition, ought to plough three-fourths of an acre in a day's work of nine hours. In the succeeding ploughing of a summer-fallow, even at the full depth, one acre may be easily executed in a day; and when the land is in fine tilth, in giving the seed furrow with a shallow slice of about four inches, $1\frac{1}{4}$ acre may be accomplished. During the short days in winter the horses are rarely employed longer than six hours, during which about half an acre may be easily ploughed. Hence it appears, that, in ordinary circumstances, an acre may be regarded as a full average for a day's work throughout the year.

In estimating the expence of ploughing, it is stated, that one efficient farm draught, consisting of a ploughman and a pair of good horses, cannot be kept up at less than L.115, on the average, per annum; and proceeding on the supposition that this draught is employed through the whole year, excepting the days on which no work is executed, the average expence of ploughing an acre of land appears not to be less than 8s. 6d.; and, in many cases, the real expence exceeds that sum. This estimate also refers to the improved method of ploughing in Scotland; and comparing it with the practice still followed in many parts of England, where the expence of ploughing the land with a four-horse team, supposing wages and horse-keeping to be the same in both countries, is stated at no less than 17s. or double the expence at which the same work is executed in Scotland, and with six horses not less than L.1, 4s. the advantage in point of economy is obviously in favour of the Scotch method. The simplicity, however, and economy of the improved plough, and the dexterity and accuracy with which it can be managed, give it a decided preference over the heavy, cumbrous, and often inefficient implements, which require great expence and power of draught to put them in motion.

Scarifying, &c.—For the purpose of saving the labour and expense of working land with the plough, after it has been subjected to its operation, as after a ploughing in autumn to prepare the soil for receiving the seed in spring, various implements have been invented, for stirring the surface, without exposing much fresh soil to the atmosphere. These instruments have been distinguished, from their mode of operation, by the names of *scarifier*, *scuffler*, *cultivator*, and *grubber*, under the last of which an implement of an improved construction has been introduced into Scotland. A description of this implement, with the method of using it, and its advantages, have been already given in the preceding chapter. A scuffler, wrought by two horses, is capable of loosening the surface of four acres in a day, and, if the soil be in good condition, even to the extent of six acres. The expence, therefore, of scuffling or scarifying an acre of land, may be estimated at from one-fourth to one-sixth of the expence of ploughing.

Harrowing, &c.—The operation of harrowing is an essential part of the labour of tillage. Harrows are employed for different purposes, as the heavy brake harrow, which is drawn by two horses, and is used for reducing strong land, or where the soil is full of the roots of weeds. The common harrow, which is drawn by a single horse, and is employed in covering the seed, and a lighter description of harrow, is in use for covering in grass seeds among grain which has already appeared above ground. The improved mode of harrowing is practised nearly in the same manner as ploughing. A man or a boy leads or drives, with long whip reins, two or three horses, each of which drags an ordinary harrow. The preferable mode of driving is with whip reins, because, in leading young and restive horses, which are frequently employed in this work, before they are fully trained, the person who leads is sometimes exposed to danger; but the driver, who is behind the harrows, is always at hand to remove obstructions from weeds, clods, or stones, among the tines, or by the harrows riding on each other. Three harrows to one driver are considered as the most economical method of conducting this kind of labour, for they cover a ridge of 18 feet in breadth at twice. In Scotland the operation of harrowing is distinguished by the expression *single time*, *double time*, and *double double*, as the ground is gone over once, twice, or four times; and as it is the usual practice to overlap each of these successively at their edges, they are then called *close single*, *close double*, &c. Harrowing is said to be *end-long* when the harrows are conducted in the direction of the ridges, and *cross-harrowing* when they proceed transversely. It is the usual practice to complete the operations of the harrow in the direction of the ridges; but some agriculturists finish off a field by cross harrowing, particularly in stiff land, under the supposition that the surface water passes off more easily from the crown of the ridge to the furrow.

Rolling.—The roller, of which different kinds have been described, is a useful implement in facilitating the labour of tillage, as in reducing turnip soil, land which is intended for potatoes, or under fallow, into good condition, or fine tilth, to admit the harrows to eradicate couch-grass, and other troublesome weeds, and to break the surface-clods on land sown with beans or barley. For these different purposes, rollers of different weights are employed, and the operation

Arable land.

is best executed across the direction of the ridges, that every part may have the full benefit of the pressure.

2. *Fallowing of Land.*

Beside the usual tillage processes which are performed in the close of autumn, during the mild weather of winter, or in the early months of spring, for the crops of the succeeding summer, certain conditions of the soil demand a more lengthened series of operations in the preparation of land for profitable cultivation. An extended period of dry weather, and the season of vegetation, are essentially requisite for the success and perfection of this extraordinary kind of tillage; and as these requisites only exist during the summer, the operations now alluded to are usually denominated *summer fallowing*.

A vague notion seems to have prevailed, and is perhaps not altogether banished from the minds of some speculative writers, that the exhausted soil requires some time for repose, to recover its wasted fertility, and hence the origin of *fallow*, or a period of rest, during which it produces no crop. No subject has excited more controversial discussion, both among speculative and practical agriculturists, than summer fallowing. Some assert, that under good management, and a proper succession of crops, it is rarely and scarcely at all necessary for most kinds of lands; while others, with equal confidence, maintain, that summer fallowing forms an essential part of a system of good husbandry, and on certain kinds of soil is altogether indispensible.

In considering the necessity and advantages of summer fallowing, it is necessary to take into view the nature of the climate, the quality of the soil, and the kind and value of the crops which are cultivated for a series of years. In certain climates, where the fall of rain is irregular or excessive, the season of field labour is greatly interrupted or extended, and in consequence of these interruptions it is often very imperfectly executed. But if, in addition to these inconveniences from the weather, the soil be wet and adhesive, the difficulty of executing completely the operations of tillage is much increased. Soils of this description, which are hurriedly or imperfectly wrought, in a short time throw up a luxuriant crop of weeds, which at last destroy or greatly diminish the cultivated crops. The ordinary method of raising corn crops, and especially when the tillage processes, from negligence or necessity, have been ill performed, does not admit of any effectual means of clearing land from weeds; and if the soil be unfit for the growth of such crops as can be managed by the drill husbandry, no remedy is left but recourse to a summer fallow, by which it may be restored to a proper condition for profitable culture.

Advantages of summer fallow.—The object of the extraordinary tillage which is pursued when land is under a clean or summer fallow, is to clear it from weeds, and to reduce it to that texture and consistence which are necessary to healthy vegetation. The more zealous advocates of this practice, although with seeming reluctance, admit that by proper management it may be restricted to soils of a clayey nature and a stiff tenacious quality. Such soils are apt to retain a super-abundance of moisture, and under an unfavourable climate are unsusceptible, either in spring or the latter period of autumn, of perfect preparation for the reception of the seed and the growth of the crop. The effects of the deficient tillage of one season are in some degree continued to the next; the soil, which becomes hard and adhesive, is overgrown with weeds; and every crop which is attempted to be raised is diminished in quantity and injured in quality. To complete the tillage processes on soils of this description may be regarded as the chief object of summer fallowing, at least in the view of those who have treated the subject on distinct and rational principles.

Arable land.

The advantages of summer fallowing are obvious in reducing soils which are wet, stiff, and adhesive, and especially those of a clayey nature, to the necessary degree of friability and minuteness of division, which not only admit the manure to be intimately blended and incorporated, but also absorb and retain a sufficient quantity of moisture, and allow the fine fibres of the roots to push out, and extend themselves with facility in search of nourishment. The destruction of weeds is another advantage which is derived from the same practice. The imperfect tillage which the state of the weather and the nature of the soil allow of being accomplished within the ordinary season allotted to that work, tends to encourage and promote the growth of noxious plants, and thus renders the extended operations of summer fallow indispensible for cleaning the soil.

It is supposed, too, that some advantage is obtained by repeated ploughing, and reducing the soil, in consequence of its exposure to the atmospheric air, which combines with the fine particles, and furnishes a larger proportion of oxygen, which latter uniting with the carbonaceous matter, produces carbonic acid, and in this way contributes to the vigorous growth of vegetables. According to the same hypothetical reasoning, the water which is absorbed by a pulverised soil is subjected to the process of decomposition, and its hydrogen uniting with the azote of the atmospheric air, forms ammonia, or volatile alkali, while another portion of oxygen combining with part of the azote, furnishes nitric acid, which, in combination with its base, potash, yields nitre; and these new compounds contribute to the improvement and fertility of the soil. Certain changes of temperature, which no doubt take place, wherever any decomposition, or change in the constituent parts of bodies is effected, are also supposed to be beneficial, either immediately or indirectly, in promoting the growth of plants.

Objections to summer fallowing.—But, on the other hand, there is some reason to suspect, as has been stated by Sir Humphry Davy, that the benefits derived from fallow have been over-rated; and although he admits that it is a necessary practice in lands overgrown with weeds, and particularly such as cannot be pared and burnt with advantage, yet it is unprofitable as part of a general system of husbandry. He rejects the doctrine, that certain principles necessary to fertility, are derived from the atmosphere, and supplied, during the repose of the land, and its

Arable land.

exposure to the air, to the pulverised soil, as well as the old opinion of the effects of nitrous salts in vegetation. By the decomposition of the weeds which are buried in the soil, a certain quantity of soluble matter is furnished; but it may be doubted whether the quantity of useful manure in the soil at the end of a clean fallow, be equal to what it contained when the operations commenced. By the action of the vegetable matter upon the oxygen of the atmosphere, carbonic acid gas is formed, but the greater part of it is dissipated and lost to the soil. The rapidity of the decomposition of the matters in the soil is greatly promoted, and the volatile fluid matters are exhaled by the influence of the sun; and, at the very time when a large portion of nutritious substance is produced, there are no useful vegetables to derive any benefit from it. When the land is unoccupied in the preparation of food for animals, it is suggested, that it should be applied to the purpose of preparing manure for plants. This object is accomplished by means of green crops, in consequence of the absorption of carbonaceous matter, which is supposed to take place in the carbonic acid of the atmosphere. But during a summer fallow no vegetables are raised, either as food for animals, or as nourishment for the succeeding crop. Even the texture of the soil is less improved than during its exposure in winter, when the freezing of the moisture it contains has the effect of reducing and pulverising it. In the drill-husbandry, the land is preserved clean by the extirpation of the weeds by the hand, and manure is supplied, either by the green crops themselves, or from the dung of the animals which feed upon them. It is the peculiar advantage of the convertible system of cultivation, that the whole of the manure is employed, and those parts of it which are less fitted for one crop are suitable for the nourishment of another. Thus, the recent manure applied to a turnip crop, affords a sufficient quantity of soluble matter for its nourishment. The succeeding crop of barley, with grass-seeds, derives from the soil, which is little exhausted, abundant nourishment from the decomposing manure, while the rye-grass and clover remain, which draw only a small part of their organized matter from the soil, and, it is supposed, consume the gypsum in the manure, which is useless to other crops. The grass and clover plants are supposed to draw a large portion of their nourishment from the atmosphere, and their roots and leaves, when ploughed down at the end of two years, and decomposed in the soil, yield manure to the succeeding wheat crop. At this period of the course, the farm-yard manure, which contains phosphate of lime and other matters of difficult solubility, is broken down; and as soon as the most exhausting crop is raised, the application of recent manure is repeated. Such are the speculations of Sir Humphry Davy on Mr Coke's system of cropping independent of summer fallow.

Pursuing a similar plan, Mr Gregg, in his system of cultivation on strong clay soil, an account of which is published in the Transactions of the Board of Agriculture, retains the ground two years in grass after barley, takes a crop of pease and beans on the ley, and ploughs down the stubble for wheat. In some cases the wheat crop is followed by winter tares and winter barley, which are eaten off in the spring, before the land is prepared and sown with turnips. But in stating this method of cropping, as the means of avoiding summer fallow, and as an objection to the practice, it cannot escape observation, that the soil alluded to, although denominated a strong clay, is adapted to turnip culture, and therefore cannot come within the description of those soils which are unfit for the growth of such crops, or those of a similar nature, which might preclude the necessity of fallow.

Arable land.

Were it possible to devise any method of cropping by which the produce, fertility, and good condition of the soil could be kept up, without the intervention of a summer fallow, which is always, in the first instance, attended with the loss of a crop, the saving would be, undoubtedly, immense. In allusion to this circumstance, Mr Middleton, in his Report of the State of Agriculture in Middlesex, when speaking of the advantages to be derived from a proper succession of crops, observes, that "the aggregate benefits to be derived to the country from this measure are not to be estimated; but among the first of these will stand the abolition of fallows, and the introduction of green crops to supply their place, over an extent of about three millions of acres of arable land, which have hitherto, under the fallow system, produced nothing useful during the fallow year. So far as tares and turnips, or potatoes or pease, and turnips or potatoes, or any two good crops can be raised in one year, in place of a fallow, the produce will be double in quantity what it has been under the former system." It is added, that there are about nine millions of acres in England and Wales in the course of two crops and a fallow; that is, six in crop and three in fallow; from which it appears, that, by procuring one crop in place of the fallow, one-half more is added to the former produce.

But it is admitted by those who contend most strenuously for the practice of fallowing on soils which are unsuitable for the turnip husbandry, that by proper management of the course or rotation, the fallow may be protracted for several years; and we have the authority of Mr Dickson of Bangholm, in the vicinity of Edinburgh, for stating his opinion of the practicability of having recourse to that system only once in 12 years, when the following six course shift, 1. fallow, 2. wheat, 3. hay, 4. oats, 5. beans, 6. wheat, is adopted, and when the wheat is cultivated according to the drill husbandry. Here it may be observed, that the soil is a fine loamy clay, and that although turnips are not included in the rotation, they follow in the second course. If, then, it appears from this statement, that the period when fallow becomes necessary can be prolonged, might it not be suggested that the extended improvement of this system of rotation might keep the land in a clean and fertile condition, and thus supersede entirely summer fallow?

According to Sir John Sinclair, in his Hints on the Agricultural State of the Netherlands, fallows are more rarely practised in Flanders than formerly, and in some districts are totally abolished. The succesion of crops which is pursued on strong land, in the neighbourhood of Bruges, is the following: 1. fallow, 2. winter barley, 3. beans, 4. wheat, 5. oats; sometimes there is a fallow every fourth year, and sometimes wheat and fallow alternate. But in the plain of Fleurus, in the Walloon country, fallows are now rarely seen. At one period, fallows were enforced, by a clause in the leases, as part of the system of husbandry in that fertile district. M. Mondez, who was well acquainted with Flemish husbandry, when he entered on the possession of a farm near Fleurus, having stipulated that he should be at liberty to pursue a different plan of management, took the lead in this improvement; and, for a period of forty years, has seldom had occasion to undertake a summer fallow. The beneficial effects of his system induced his neighbours to imitate and adopt it. The course of cropping pursued by M. Mondez, and in which a fallow is not introduced, is the following: 1. winter barley or wheat, 2. rape, 3. half wheat half rye, 4. clover, 5. oats, 6. flax; or where flax is not cultivated, the course proposed is, 1. winter barley, 2. rape transplanted; 3. wheat, 4. clover. The culture of beans is succesfully practised, instead of a fallow, by M. Wieland near Ostend. The beans are succeeded by an abundant crop of wheat or winter barley; and it is added by the agriculturist now alluded to, that "this system merits to be encouraged, from the great advantage derived from it; for, without any additional manure, which, however, it tends to furnish, it retains the fields in as high a state of fertility as can be done by the fallow system; it exacts but a moderate degree of attention, and it requires neither any extraordinary expence, nor hazardous combinations."

Sir John Sinclair informs us in the work just mentioned, that it is now a maxim in the plain of Fleurus, where fallows are nearly abolished, that whenever it is possible to manure the land fully every ninth year, they are perfectly unnecessary; and the same author notices a paper on this subject by M. Burtin of Brussels, who recommends mixing sand with the soil, to alter and improve its texture, and burning clay in large masses for the same purpose, as a substitute for fallows.

In Switzerland, fallowing was so much practised at one period, that it alternated with every crop; but now it is said that fallows are totally abolished in that country, and the rotation which precludes the necessity of that practice is, 1. wheat, 2. carrots, 3. vetches, 4. barley, 5. potatoes.

It has been already noticed, that the fertility of the soil which is frequently turned up and exposed to the atmosphere during the course of a summer fallow, instead of being improved and enriched by receiving something from the air, is actually impoverished by the loss of those volatile ingredients which might have contributed to the nourishment of a crop. But it can scarcely be doubted, that the saline or soluble matters in the soil, which are necessary to the growth of vegetables, are either entirely washed off the land, or carried downwards into the sub-soil, in the progress of the fallowing operations. It is supposed, indeed, that some compensation for this loss is obtained from the additional manure furnished by the weeds which are ploughed down. It seems, indeed, not improbable, that the soil is in a worse state in point of fertility at the conclusion of a clean fallow than it was at the commencement; and it deserves serious consideration, whether in any or in all the cases in which this system is adopted, any mode of practice could be devised which could obviate this loss, and at the same time secure the advantages of a clean soil with an improved texture. It would be easy to institute a series of experiments for the purpose of ascertaining the change which takes place in the fertility of the soil after a clean summer fallow. If two portions of land in the same situation, of the same nature and quality, and of the same extent, were marked, and if the one were put under a hoed or drilled crop of any description, while the other is at the same time subjected to the usual processes of fallowing; and if in the succeeding years the same crops were raised on both,—the amount and quality of the produce would furnish a fair estimate of the difference of fertility, if any existed, in the two portions of land thus treated.

Operations of fallowing.—When a summer fallow is determined on, the first operation is a ploughing immediately after harvest, and it is recommended that this ploughing should be as deep as the soil admits. In many cases, it is found beneficial to bring up a portion of the sub-soil, by means of which deep rooted weeds are loosened, and some addition of fresh earth, provided it be not of an injurious quality, is made to the cultivated soil. The decay of the stubble and weeds which are turned down, is greatly promoted by this ploughing. But, if circumstances prevent this first part of the process from being completed about the end of autumn, it must not be omitted during a favourable time in the winter months, or early in the spring season. In the first ploughing, if it can be accomplished, the old ridges are gathered up, that the soil may be kept dry through the winter. But if the ridges in their former state were considerably raised, it is not unusual to split or divide them into two; and sometimes when the land is dry, it is ploughed according to the method denominated crown and furrow, or the furrows and crowns are exchanged, the former becoming the crown and the latter the furrow of the new ridges, and sometimes two ridges are ploughed together by casting.

When the field is ploughed, all the furrows, as well those which divide the ridges, as those between the extremities of the ridges and head ridges, are to be carefully opened up by the plough, after which every remaining obstruction is to be removed, that there may be no interruption to the escape of the water. Attention also is necessary to the hollow places in the field, that a free outlet for any water that is apt to collect may be made. No water should be allowed to stagnate in any part of the field.

When the spring seed-time is over, the fallowing operations are resumed by another ploughing; and if the ridges were formerly split, they are now ridged up, and if the ridges were formerly gathered, they are now split. The field is subjected to a cross-ploughing; and after remaining a sufficient length of time to become dry, and to be fit for harrowing, it is repeatedly harrowed and rolled, to reduce and break down the soil to a proper and uniform consistence, while all kinds of roots and weeds which are raised to the surface are carefully collected into heaps to be burnt in the field, or carried off to form compost manure. The fallow is then ridged up, which prevents any injury from rainy weather, and a new surface is presented to the action of the harrow and roller; and after harrowing, the weeds are again collected and treated in the same way. The operations of ploughing, harrowing, and rolling are repeated, till the soil is completely cleared of weeds, and reduced to that uniform state of minute division, or of texture and consistence which is well known by the name of fine tilth. It must be observed, too, that in each successive operation, the weeds which spring up from seed are turned down and destroyed; and hence summer fallowing affords the best opportunity of clearing land which is infested with such noxious productions.

Some diversity of opinion prevails with regard to the implements employed in the fallowing process. Repeated ploughings, some think, are only necessary for the destruction of root weeds, which being turned up and exposed to the action of the sun and air, are completely deprived of their vegetative powers, and thus are not only rendered harmless, but are made to contribute, in their decomposition and decay, some useful ingredients for enriching the soil. But it appears from ample experience, that couch-grass and other root weeds can rarely be extirpated from some soils by the operation of the plough, to the exclusion of the harrow and roller. In stiff adhesive clay grounds, the soil is raised in masses or clods, which in no period of a dry season are so reduced as to permit the included roots to be affected by the drought, and to wither and decay, or the inclosed seeds to vegetate and spring up, that they may be afterwards buried under the surface and destroyed. In such cases, the application of the harrow and roller is most essential;—by the action of the latter, the earthy clods or masses are broken down and reduced to a loose friable mould, and by means of the former, the same effects are still farther extended, while at the same time the detached roots and weeds are dragged to the surface, and may then be collected by manual labour, carried off the field, or thrown into heaps to be burnt, and the remains blended with the soil.

By such operations the land is effectually cleaned from all kinds of noxious vegetables, and brought to that uniform degree of friability, or state of fine tilth, which the healthy and vigorous growth of the cultivated crops requires. The object of the last ploughing is to form the ridges. This is accomplished exactly in the same way as has been already described for striking the furrows; and as all traces of the former ridges are entirely obliterated, the direction, breadth, and other circumstances of the new ridges, may be accommodated to the nature of the crops to be raised, or the particular system of husbandry to be adopted. In preparing for a drilled crop, for instance, the breadth of the ridges is made to correspond with the proportions of the drilling implements in use.

In Norfolk, a kind of fallow, provincially denominated a *bastard summer till*, is occasionally practised. If it shall appear that a piece of ground, from which clover, or some other cultivated grass has been cut, is not sufficiently clean for the reception of the succeeding wheat crop, it is ploughed two or three times, if it can be accomplished, before harvest; and when it is necessary, the assiduous application of the harrow and roller is not to be neglected. For the purpose of cleaning pea stubble, it is also sometimes subjected to a similar series of operations. When the crop of pease is removed from the land, the straw is harrowed up, collected, and carried off. A single ploughing is given; after which the ground remains in that state till the conclusion of the harvest, when it receives two cross ploughings, and a fourth as a preparation for the insertion of the seed.

Application of manure.—When manure is necessary for land which has been under summer fallow, the fertility of the soil, the state of its tillage, and the nature of the manure, serve to direct the mode of its application. In cases where lime, or other calcareous matter, is found requisite, the summer months are properly recommended as the best time for spreading it on the land; but particularly after the mechanical operations on the land are completed, that it may be ploughed in with a slight furrow, not buried deep, which should be carefully avoided, but thoroughly blended and incorporated with the soil, that its effects may not be placed beyond the reach of the vegetative processes on which they are expected to operate. When farm-yard manure is applied, it is most beneficially inserted with the seed furrow, by which the vigorous growth of the crop is promoted by a regular and copious supply of nourishment in the early stages of its progress. The rich verdure and luxuriant appearance of the first crop after fallow, managed in this manner, afford ample proof of the advantages of this practice. In some cases, the abundant supply of vegetable matter to the soil by the decay of an abundant growth of weeds, may render the application of manure less necessary; but it may be fairly doubted, whether the unavoidable waste of fertility in the course of a summer fallow may not require some compensation, so that a certain portion of some enriching matters may be generally considered indispensible. It has been supposed to be a more economical practice to reserve the manure, and apply it to the second crop in succession after the fallow; but this point, it is obvious, can only be correctly determined by the comparative fertility of the soil.

Sect. III. *Drill husbandry.*

For the successful practice of the drill husbandry, or the method of inserting the seed in rows, or drills, the various tillage operations require to be executed with greater care, accuracy, and neatness than are usually bestowed on land when the ordinary broad-cast manner of sowing is adopted. This method of cultivating grain in drills is also denominated the *New Husbandry*, to distinguish it from the broad-cast system, and on account of its later introduction into this country; although it is supposed that the practice of cultivating grain and other crops in drills has

Arable land.

been known and followed in eastern countries from the remotest periods.

The drill husbandry was introduced into Britain by Mr Jethro Tull, a Berkshire gentleman, who began to cultivate his own property according to this method about the year 1713, and hence it has been called *Tull's Husbandry*. Struck with the remarkable effects which this method of managing arable land produced, and ascribing to the more perfect culture which was practised, rather than to the fertilizing properties of the manure, the more abundant crops which he obtained, like other speculatists, his partiality to his own system became excessive, and led him to disregard the benefits derived from manure, and even to consider its application as a needless waste of labour and expense. By thus over-rating the advantages of drilling crops, and by this erroneous view of the effects of this method, the introduction of the practice was probably much retarded. In the present day, when the utility and necessity of manure are so well understood and fully appreciated, no great danger exists of any person of ordinary intelligence, without some peculiar predilection, being misled by such a doctrine, and far less to venture to direct any extensive practice by such tenets; although we have heard that Mr Tull has still one follower, who thinks that perfect tillage is all that is necessary for the production of abundant crops.

In the broad-cast system, although not a necessary consequence of the practice, the land is often not in a proper condition or state of fine tilth; the seed is often scattered at random; in some places it is too thick, in others too thin, which allows weeds to spring up, so that labour and manure are wasted in vain; the seed is often imperfectly covered; part of it is carried off by vermin; part is exposed on the surface to rain, frost, and drought; the unequal depth at which it is placed, produces an unequal crop; and the soil cannot be stirred, or the weeds destroyed, without great expense or injury. But the drill-husbandry is free from most or all of these inconveniencies and defects. The land must necessarily be better tilled; the seed is regularly inserted, and it is placed at equal depths, which secures a clean and equal crop; by being speedily and equally covered, it is protected from vermin and injuries of the weather; weeding by the hand or horse-hoe is executed more completely, without risk of hurting the growing crop; by the repeated stirring of the soil, the roots of the plants have the full advantage of its fertility; the pulverised soil absorbs more freely the moisture necessary for the growth of the plants; and the intervals between the rows admit a free circulation of air, which is also essential to healthy vegetation.

The advantages derived from the practice of drilling are stated to be, a saving of seed; its more regular and certain growth and maturity, from being more regularly deposited; a more abundant crop, and of better quality; the more certain and easy destruction of weeds; harvesting the crop at less expense, as it is free from grass and other weeds; and the soil being left in a more friable state, and in better condition, which renders it more productive for future crops. The objections to this system of husbandry refer to the requisite dexterity and accuracy in performing the necessary operations—qualifications which are not always possessed by common labourers; the superior culture which must be given to the land, and for which every soil is not suitable; the thinness of the crop, the supposed waste of land, and the unproductive crops which have succeeded those that were drilled. Some of the objections now enumerated, it is pretty obvious, have their origin in prejudice, and others are undoubtedly to be ascribed to partial and inaccurate observation.

The comparative experiments of Mr Amos, which are fully detailed in his Treatise on Drill Husbandry, exhibit, in a distinct point of view, the superior advantages of this method. These experiments, which commenced in 1783, were made on soils of different qualities; and in all of them, two acres of land, laid up in ridges of 11 feet, and drilled and sown broad-cast, alternately, were employed. For the entire details, we refer to the work itself; we propose, for the sake of brevity, to state only the results; and the sum, opposite to the name of the crop, denotes the superiority of the drilled crop.

	L.	s.	d.
Oats on stiff loam, - -	1	3	0
Cole-seed after the oats, - -	0	1	0
Barley after the cole-seed, -	1	5	3
Beans after the barley, -	1	1	3
Wheat after the beans, -	1	14	5
Turnips on sandy loam, -	0	8	9
Barley after the turnips, -	0	17	10
Red clover after the barley, - -	0	10	6
Wheat after the red clover, -	1	9	9
Potatoes on sandy loam, hand and horse-hoed, in favour of the latter	3	13	10
Barley after the potatoes, -	1	16	2
Red clover after the barley, -	0	13	6
Wheat after the red clover, -	1	16	0
Cabbages, on stiff loam, horse and hand-hoed, in favour of the former	2	10	9

But we have to adduce a recent and still more decisive experiment in favour of drilled crops, which was made on a considerable scale, in the year 1815, by one of the most accurate and intelligent agriculturists, in a district where husbandry has attained a high degree of perfection. Mr Dickson of Bangholm, now alluded to, whose opinion of fallowing we have already stated, has distinctly and satisfactorily ascertained, that his crop of drilled wheat, on a black, sandy loam, yielded one-fourth more produce than an equal quantity of land of the same quality in the same field sown broad-cast. The quality of the drilled wheat also maintained its superiority over the other; for it was from four to six pounds heavier in the bushel than the produce of the broad-cast sowing, and the quantity of light grains in the former was less than one-half of what appeared in the latter. It ought to be added, that though Mr Dickson employed the same quantity of seed in both methods of sowing, the drilled seed was inserted in a furrow of six inches, and that he considers the saving of seed, which has been held out as one of the advantages of the drill-husbandry, as rather injurious, and as the cause of a deficient crop.

A remarkable difference is observed in the produce of drilled crops in the same kind of soils, from a difference in the distance between the rows or drills. This is strongly exemplified in the crops of potatoes and cabbages, noticed above, in which the more abundant crop was obtained from the wider drills, if part of the superiority be not ascribed to the difference of culture between the use of the horse and hand-hoe. A comparative view of the produce of different crops of grain and pulse, drilled at different distances, is given by Mr Young, in his Eastern Tour. But it seems doubtful whether any useful results are to be obtained from this comparison; because it is made on very different soils, in different situations, and under the management of different persons. It would seem, in general, that the most abundant crops were raised in the wider drills, at least within certain limits; and it must be observed that these limits are narrow; for when the difference is considerable, the result was greatly varied. The wheat crops were drilled from eight to 18 inches; the barley and oats from nine to 12 inches; the beans from nine to 20 inches; and the pease from 10 inches to two feet.

It is a curious fact in the history of agriculture, that Tull proposed and practised the drilling of wheat, barley, and other corn crops, in distinct rows, at the distance of three or five feet from each other. In this practice, as might be expected, he has found few followers. But although this extravagance in his system be laid aside, its importance and value have not been overlooked. Drilling is practised in rows of eight or ten inches distant, for the purpose of hand-hoeing; in rows at the same distance with the view of saving seed; and green crops are drilled and horse-hoed, to preclude the necessity or frequent recurrence of summer fallow. By sowing in drills at eight or ten inches, to admit the operation of hand-hoeing, taking the previous culture and the clean condition of the land, which is the consequence of attentive management, into the account, very abundant corn crops have been produced by Mr Ducat, at Esher, in Surrey, who has practised this method on a larger scale than any other agriculturist in the kingdom. But the requisite number of hands, it seems probable, is not always and in all situations to be procured for such extended operations. It is doubtful, from the fact noticed above, where the same quantity of seed was used in drilling as in broadcast sowing, whether, in all cases, the saving of seed ought to be considered as one of the advantages of the system. The compensation for the extraordinary previous tillage to bring the land into good condition for the drilling process, and for the additional labour which is necessary to keep it in a clean state in the progress of the crop, is to be sought for rather in the more abundant produce than in the saving of seed. The drilling and horse-hoeing of green crops is justly regarded as one of the most beneficial improvements in modern agriculture. It is considered very properly as an extension of the garden culture to the field, which some writers seem disposed to think is a thing altogether impracticable, and affect to treat even the most distant hint of the possibility of so refined an improvement with an indignant sneer, as if the progress of art had reached its utmost boundary, and the wants of man did not still exist to rouse ingenuity and stimulate labour to useful exertion.

In the preparation of land for the drill husbandry it is not necessary to repeat the directions already laid down for conducting the operations of perfect tillage, either in the case of ordinary practice, or in that of summer fallowing. It is sufficient to remark, that the ground on which a drilled crop is proposed, should be in the best condition with regard to the texture of the soil, and its state of cleanness. The quality of the soil, and the kind of drilling apparatus to be employed, regulate the proper breadth of the ridges. On a moist soil narrow ridges are necessary, but ridges of a greater breadth are preferred on a dry soil. The general breadth, when not otherwise limited to the drilling machine, is from five or six to fifteen or eighteen feet.

The distance between the rows in drilled crops varies according to the nature of the soil, and the kind of plants which are cultivated. On light soils, the drills should be closer than on those of a stronger and richer description. The distance between the rows for most kinds of corn crops, is recommended to be from ten to fourteen inches, and on poor soils eight inches; for beans, pease, and turnips, when drilled in double rows, at the distance of nine inches between the rows, and 27 inches in the larger intervals; but some writers are of opinion, that 10 or 12 inches are a sufficient distance for turnips, rape, and similar crops in poorer soils; and for carrots 14 inches is considered a proper distance.

Sect. IV. *Of the Culture of different Crops.*

The observations which have been offered on the subject under consideration, respect the nature of the soil, the means of improving and the methods of preparing it for the reception of the seed, and the growth of plants. Our attention is now to be directed to the particular management of the different kinds of crops which are usually raised upon it; and as the same succession of crops is never produced in all soils and situations, it seems of little importance in what order they are treated. The proper rotation of crops, which is regulated partly by the quality of the soil, and partly by local circumstances, will be discussed in the next section.

Of the plants which are produced on arable land, some are cultivated for the sake of their seeds, as the grain crops; some for the sake of their leaves, as the grasses, clover, cabbages; and some for the sake of their roots, as potatoes, turnips, carrots.

1. *Wheat.*

The soils which are the most suitable for the culture of wheat are those of a strong, loamy, or rich clayey description; but where an abundant supply of manure can be obtained, and when the climate is favourable, wheat may be profitably cultivated on soils of a lighter nature, as on any kind of clayey or loamy soil. On a strong soil, in good condition, and in a clean state, wheat may be raised every second year, alternating with some green crop.

Preparation of the land.—Wheat is often the first crop after summer fallow. In the application of manure to this crop, and those which are cultivated in the rotation, it is sometimes inserted at the conclusion of the fallowing operations, and sometimes, as has been already noticed, it is deferred to the next crop, and then it is applied to the wheat stubble for drilled beans. This is regarded by some as the best preliminary preparation for the next wheat crop. The limitation or extension of the course depends on the state in which the land is kept with regard to cleanness from weeds during the drilled bean crop, and on the manure which it receives, to keep up the proper degree of fertility. By this management, a rotation of fallow every fourth year, two crops of wheat, and an intermediate crop of beans, with a single application of manure, may be advantageously established. But if the fallow be introduced every sixth year, three crops of wheat and two crops of beans, with two applications of manure in the course, may be taken; and with three applications of manure and a fallow every eight year, seven crops may be raised in succession, namely, four of wheat and three of beans. On the different courses now noticed, it may be observed that the proportion of manure is smallest in the first, and soil of a good quality is found to continue in a proper degree of fertility. But in the other two, the rotation cannot be long persevered in without the extraneous acquisition of manure, and this can only be secured in the vicinity of large towns, or the disproportionate application of what is produced on the land.

Although wheat be generally sown after the land has received the preparation of a complete summer fallow, it may be raised to more advantage, according to some agriculturists, after different kinds of green, root, and other crops. The practice of sowing wheat after fallow is strongly reprobated by Mr Young, in his Calendar of Husbandry, who remarks, that " if there be one practice in husbandry proved by modern improvements to be worse than another, it is that of sowing wheat on fallows." " If fallows, (he says) be thought necessary, let them be sown with barley or oats, or any thing but wheat. But wheat may be advantageously cultivated after clover, tares, pease, beans, turnips, potatoes, and similar crops, regulating the succession according to the nature of the soil and the condition of the land." Beans which have been under suitable culture, are considered by Mr Young the best preparation for a crop of wheat; and in the opinion of the same author, clover and tares come next in order as preparatory crops.

The place which the wheat crop holds in a six course shift, on a fine loamy clay soil, in the highly cultivated district of East Lothian, in Scotland, is the following: 1. fallow; 2. wheat; 3. grass; 4. oats; 5. beans; 6. wheat; and, with an intermediate application of manure, all the crops are abundant; and besides, if the wheat be drilled, which affords an opportunity of clearing the ground from weeds, the fallow may intervene only once in 12 years. With the advantage of manure from Edinburgh, which compensates what is lost by the produce sold off the possession, Mr Dickson's rotation at Bangholm is, either, 1. potatoes; 2. wheat, drilled; 3. clover, cut green;—or, 1. turnips; 2. wheat or barley; 3. clover, cut green. The soil on which this succession of cropping is pursued, is partly a black sandy loam on a retentive sandy sub-soil, and partly a light sandy loam on a dry sandy under-soil.

Whether wheat be sown on fallow, or whatever be the preceding crop, it is scarcely necessary to observe, that the soil should be in a friable and pulverised state, and completely cleared of weeds. When wheat succeeds beans, the state of the weather in a variable climate may seldom permit more than one ploughing. But before this is attempted, the preliminary operation of cross harrowing the land is recommended, for the purpose of levelling the ridgelets, and of allowing the work of the plough to be executed with greater accuracy and neatness. To preserve the crop from the effects of moisture during the winter, the ridges should be gathered up, and, it is needless to add, that the furrows in all cases should, with the same view, be kept free and open. A greater degree of attention is necessary to the ploughing operations when wheat is sown after clover, that the grass roots may be completely buried and covered up; for when this labour is carelessly executed, the roots are apt to vegetate and send up shoots, to the great injury of the wheat in the early stages of its growth. To obviate this inconvenience, it is the practice in some districts to use the skim-coultered plough, or the common plough, to the coulter of which an iron fin or plate is attached, by means of a screw, at the distance of about four inches from the point, for the purpose of cutting or skimming off the remains of clover and grass plants from the surface, and turning them into the bottom of the furrow. By means of this implement the land is better cleaned, and the harrowing is more perfectly executed. In some cases, where the land has been two years under clover, it is broken up about the latter end of June, and receives two, and sometimes three ploughings. In favourable situations and seasons, when the soil can be brought into good condition, this practice, which is pursued in Norfolk and Warwickshire, holds out the advantage of a cutting of grass in the early part of the season when the land is broken up.

Kinds of wheat.—The varieties of wheat which has been cultivated for such a length of time, and in such diversity of soil and situation, may well be expected to be very numerous; and these varieties, it is remarked by attentive observers, are annually increasing. All the kinds of wheat which are usually cultivated in this country, are included under the smooth or polled wheat, and the wheat with a rough or bearded ear. The first, or the smooth wheat, as it affords the finest kind of flour, is more generally cultivated where the soil is suitable; and the second species, sometimes known by the name of *rivet* wheat, yields a larger crop on the more stiff and wet clayey soils, and is less subject to diseases, so that it is preferred for such lands. The common wheat is best adapted to dry soils; and the bearded or *rivet* wheat is thought by some to be most suitable for lands that have been newly broken up, where the excessive luxuriance of the crop may occasion the grain to be lodged in wet seasons; for in this kind of wheat the straw is firmer and stronger. The white and red varieties of the smooth wheat are in most general estimation; the first yields the whitest flour, and the last the most abundant produce. The varieties of wheat now mentioned are referred to the species *triticum hybernum* of Linnæus. The wheat which is usually sown after turnips belongs to the same species, and is called *spring wheat*, because it is sown in the spring season. It is worthy of notice, that the produce of spring-sown wheat should always be employed for seed at the same season; for it has been found from repeated experience, that the crop ripens a fortnight earlier than when the seed is taken from winter sown wheat. This is a point of importance at all times; but where there is danger of a late harvest, it is of no small moment. The true spring, or summer wheat, *triticum æstivum* of Linnæus, is a distinct species. In England it is sometimes known by the name of *May wheat*. It is supposed to be a native of Tartary, and was introduced into this country about the year 1773, under the name of Siberian wheat, and Switzerland wheat. This species has been extensively cultivated in Berwickshire and East Lothian, but has turned out to be inferior to the varieties of the Lammas or winter species, which have now replaced it.

It would be extremely difficult to describe all the varieties of wheat under cultivation in different districts, and, indeed, it could answer no good purpose; for it is probable that the same variety is distinguished by different provincial names in different places. The white varieties of wheat have been divided into the *thick-chaffed* and *thin-chaffed*, a distinction which is sufficiently correct, from the diversity of character of the two kinds. The thin-chaffed wheats are more hardy, and less liable to be affected with mildew, two very valuable properties, on account of which the culture of this variety has greatly increased in some of the most improved districts of Scotland. A variety selected by Mr Hunter of Tynefield, in East Lothian, is now in great estimation, on account of its superior produce and hardy character. It retains a green, healthy, and vigorous appearance in the coldest weather, when other wheats become languid and yellowish, and yields an abundant produce of excellent flour. In some parts of Berwickshire and Northumberland, a variety called *creeping* wheat, which belongs to the red wheats, is found to be very suitable for coarse clayey and moorish soils. The name is derived from its supposed tendency to push out suckers. It is a hardy and prolific variety on inferior soils. Beside the species mentioned above, there are others which are cultivated in different countries. One-grained wheat, *triticum monococcum*, is raised in Germany, and answers well in poor soils and exposed situations. In a trial with this grain in Scotland, it was sown on the 12th May, rose on the 27th, flowered on the 15th August and was fully ripe on the first of October. Spelt, *triticum spelta*, is also cultivated on the most barren soils in Germany. It was tried in Scotland, in a field 600 feet above the level of the sea, and ripened in the beginning of September. Smyrna wheat was brought from that place to France where it is extensively sown, at least in the northern districts on account of its superior produce.

Preparation of Seed.—It seems to be fully ascertained, that the produce of wheat sown without any preparation is more liable to be affected with the diseases to which that grain is subject, than the seed which has undergone some kind of preparation; and hence the practice of submitting seed-wheat to certain processes before it be deposited in the earth, is very rarely omitted. The experiments of M. Prevost, quoted by Sir John Sinclair in his Hints on the Agriculture of the Netherlands, shew the advantage of previous preparation in preventing smut in a striking light; the results were the following: 1. Infected grain without any preparation had one-third of the crop smutted; 2. Infected wheat, simply scalded, gave one-fifth smutted; 3. Sound wheat, without any preservative, had one-fifth part infected; 4. Infected wheat, well moistened in a solution of blue vitriol, or sulphate of copper, in the proportion of nearly two ounces for every three bushels of wheat, had only one hundredth part affected with smut; 5. Infected grain, well moistened with a solution of the same kind, in the proportion of about 4½ ounces of blue vitriol to three bushels of wheat, gave only one three hundredth part smutted. This solution is stated as being equally effectual in preventing mildew.

The method of preparing seed-wheat by this process, is the following. Three ounces and two drams of blue vitriol are dissolved in nearly four gallons of cold water, and this is the proportion allowed for every three bushels of wheat to be prepared. Into another vessel, capable of containing sixty or seventy gallons, throw from three to four Winchester bushels of wheat, and pour upon it the prepared liquid, till it rises five or six inches above the corn; stir it well, and remove the light grain from the surface. The wheat, after being half an hour in the solution, is thrown into a basket to allow the liquid to drain off. The seed is then washed with pure water, and well dried before sowing. It is said that it may be kept after this process quite sound for several months. A similar application of blue copperas is practised by Mr Butler of Derbyshire. He dissolves two pounds of the blue vitriol in as much urine as can moisten twelve bushels of wheat, and after it has soaked a sufficient time it is dried with quicklime.

The successful operation of the above mode of preparing seed wheat, has induced us to describe it at length. But whether it be more effectual than the ordinary methods practised in this country, which are preferable in point of economy, we have had no opportunity of obtaining precise information. Brine, or the solution of common salt in water, is strongly recommended by some as an excellent preservative for securing wheat from smut. The solution is made pretty strong, and the seed-wheat is thoroughly steeped in it. Sea-water, when it can be obtained, is sometimes employed, on account of being a cheaper application, as a substitute, with the same view. But it may be necessary to add a portion of salt to bring it to the proper degree of strength.

The most economical steep for seed-wheat is certainly stale urine, and it is at the same time, in the opinion of most agriculturists, one of the most efficient applications for preventing smut. The method of using it is thus described in the General Report of the Agriculture of Scotland: "Take four tubs, two smaller and two larger, the former of a size to hold about a bushel of wheat, and the latter large enough to hold the smaller within them. The smaller tubs have wire bottoms. Fill one of the large tubs with water, and, putting the wheat in the small one, immerse it in the water, and stir and skim off the floating grains; renew the water, and continue the operation till it come off nearly clear; then take out the vessel containing the wheat, and immerse it in the other large tub which is filled with urine. When thoroughly washed and skimmed let it drain; then throw it on a clean floor and riddle quick lime upon it, turning it over and mixing it with a shovel till it is sufficiently dry for sowing. Sprinkling the seed with urine is also found to answer the same purpose; and it should be observed, that seed prepared with urine must be sown immediately after the operation, for if kept long it runs the risk of being deprived of its vegetating power.

Kiln-drying is stated as an effectual preventative of smut; but great care is necessary in conducting the operation, to avoid such a degree of heat as might destroy the powers of vegetation. Passing seed wheat through rollers, which separates a black powdery matter from the surface of the grain, has been for many years successfully practised by Mr Henderson, near Wooller in Northumberland, for securing the crop from smut; and the same method has been adopted by Mr Dickson at Bangholm. An objection was made to this operation, that the vegetative functions of the grain might be destroyed; but the appearance of Mr Dickson's crop affords ample proof that the objection is groundless.

Time of sowing.—The nature of the soil, the state of the weather, and the preceding crop, must often occasion variations in the time of sowing wheat. When wheat succeeds a fallow, it may be sown from the end of August to the middle of November; or where the climate is favourable, as late as December. Some think that the best season, whether on fallow, or once ploughed clover stubble, is from the beginning of September to the middle of October. In East Lothian, on good dry gravelly loam, it has succeeded well after a clover crop when sown in November. On wet clay soils, an early sowing is recommended, to preclude the danger of losing the opportunity of completing the harrowing operations till the spring. For cold backward soils, September is considered the best season; and for soils of a warmer and drier description, October is preferred by some for sowing wheat.

When the sowing of wheat is deferred till the spring, the seed may be inserted at any favourable time from the beginning of February to the middle of March. When later, in Scotland, than the second week of March, the success of the crop is considered doubtful. But in the southern districts of the kingdom, the sowing season may be protracted to the end of April or beginning of May.

Methods of sowing.—Wheat is sown either broadcast or in drills. The first method is most generally employed, especially on the stronger kind of soils, whether they be of a clayey or loamy nature. The seed is cast over the surface in the usual manner, after the last ploughing, and immediately covered in by the operation of the lighter kind of harrows. In some districts the seed is sown in a partial manner, one portion being covered by the second or third ploughing, and the other afterwards harrowed in. But no great benefit seems to be derived from this method; and indeed if the business be not carefully executed, and particularly if the seed be not turned in with a shallow furrow, part of the seed may be lost, and an unequal crop may be the certain consequence. In broadcast sowing the seed must be deposited at a very unequal depth.

Drilling, or sowing wheat in rows, is more generally practised in the southern than in the northern districts of the kingdom. The distance of the rows is from nine to fourteen inches, varying according to the condition and fertility of the soil. The seed is usually deposited by machines, which sow several rows at once. The breadth of the ridge is often accommodated to the machine; and in this case half the ridge is completed by one journey, or the whole breadth is sown by once going and once returning along the ridges. Drilling is attended with the advantage of regulating the depth of the seed, which is extremely uncertain and unequal in the broadcast method. This depth is varied in different soils from two to four inches. Mr Dickson of Bangholm, near Edinburgh, whose practice in drilling has been remarkably successful, sows wheat in a furrow of six inches deep. The distance between the rows is from ten to twelve inches in the lighter kinds of sandy loam soils, fourteen inches on a stronger description of soil, of the nature of black sandy loam. The advantages of Mr Dickson's method of drilling over the broadcast sowing in the same soil, and in the same field, fully warrant its recommendation where the soil and situation are similar. The produce from a comparative estimate was at least one-fourth greater, the grain was of a better quality, weighing from four to six pounds heavier, and there was not half the quantity of light wheat.

Quantity of seed.—The quantity of seed varies according to the fertility of the soil, the state of the climate, and the period of sowing. On a rich soil, in good condition, and sown early, the quantity need not exceed two bushels for each acre. From two to three bushels, and in some cases a little more, may be considered as the extreme proportions. When sown on bean stubble, the quantity ought to be greater than on fallow; the proportion on clover ley should be larger; and the allowance of seed to turnip land sown in spring is recommended to be still more liberal. The English acre is here alluded to.

After-management.—It is scarcely necessary to urge the advantage of keeping the land sown with wheat free from water at all times, by opening up all the furrows, to allow it to have a free outlet. Weeding, as far as it is practicable, should never be omitted. This is very limited in fields sown broadcast. Thistles, and larger plants, which can be removed by the hand, can only be destroyed. But in the drilled method the business of hand-hoeing can be effectually executed; and it is not less beneficial to the crop in stirring the soil and closing it on the roots than in eradicating the weeds.

When grass-seeds are sown in the spring they are covered in by harrowing, an operation which is also useful to the wheat crop, and is often had recourse to in the latter view alone, for loosening and pulverising the soil, which is apt to cake and become hard in the course of the winter. Rolling wheat-lands in the spring, especially such as are of a porous description of soil, is a very beneficial practice, in giving it the proper degree of texture and consistence, as well as in breaking down and reducing any hard masses or clods of earth. Hand-hoeing is employed sometimes before the sowing of grass-seeds, to prepare the surface for their reception, and sometimes after they have been deposited, for the purpose of covering them in, according to the condition of the soil and the state of the weather.

By loosening the earth, and closing it round the stems of the plants, *tillering*, or the production of new stalks, is greatly promoted, and particularly in the drill-husbandry. Some curious facts of the wonderful multiplication of grain by this process are recorded. In a moderately good crop of drilled wheat, Sir Humphry Davy has counted from 40 to 120 stalks from a single grain; and he quotes Sir Kenelm Digby, who saw, in 1660, in the possession of the Fathers of the Christian Doctrine at Paris, a plant of barley which they preserved, and which consisted of 249 stalks from one seed, and yielded 18,000 grains. He refers also to Mr Miller of Cambridge, who sowed some wheat on the 2d of June 1766, and on the 8th of August a plant was taken up, separated into 18 parts, and replanted. In September and October they were again taken up and divided into 67 separate parts, to remain during the winter; and in March and April they were also taken up, when they produced 500 plants. The number of ears from a single grain amounted to 25,509; and the grains were estimated at the amazing number of 576,840. The produce, weighing 47 lb. $7\frac{1}{2}$ ounces, measured three pecks and three quarters of corn.

When blanks or thin spaces appear in the wheat grounds, from the effect of frost or the ravages of the wire-worm, which are not unusual, especially in broadcast sown fields, it has been the practice in some of the northern districts of the kingdom to sow barley in the vacant spots. A better method of accomplishing the same purpose, is to sow summer wheat, *triticum æstivum*, which, although inserted as late as the first week of May, arrives at full maturity as soon as the crop of winter wheat.

The feeding down of wheat crops is a practice which has been resorted to in some districts, when they appeared too forward or luxuriant in the early spring months. Some benefit was supposed to be derived from the removal of the upright central stems by which the growth of the lateral shoots become more vigorous; but if this practice be at all useful, it should undoubtedly be limited to crops of excessive luxuriance, or in strong and fertile lands. Some advantage is also supposed to be derived from the treading of the animals on the lighter and looser kinds of soil, by which the earth is pressed more closely to the roots of the plants; but in many cases it is suspected this practice is injurious, by retarding the period of blossoming, and checking the growth of the stems.

The wheat crop is often attacked by worms, slugs, and insects. To destroy these animals, and prevent their ravages on the grain, top-dressings of various substances have been employed, such as sea-salt, lime, sand from the sea-shore which is often covered by the tides, and soot; but it should be observed, that such substances as are of a corrosive nature should be applied in small quantity, and very equally distributed, that the young plants may not be injured. Rolling the land in the spring months, early in the morning, is recommended for destroying snails, slugs, and grubs.

Diseases of wheat.—Wheat, although to be considered a hardy plant, is more liable to diseases than other crops of grain. In the disease called *smut*, the substance of the grain is converted into a black powder, which is similar in its chemical properties to the dust of the puff-ball or dusty mushroom, *lycoperdon globosum* of Linnæus. Sir Joseph Banks, who has investigated the nature and progress of this disease with a good deal of attention, concludes, that the grain is destroyed by a small parasitical plant of the fungus tribe; but in what way the plant is propagated, it is impossible to say:—Can it be by the minute seeds being taken in by the roots, carried along with the juices through the vessels, and deposited in the ear where it vegetates, according to certain speculations; or by the seeds being wafted through the air, according to a prevalent popular notion, that the disease is conveyed from the barberry tree, in which a species of fungus sometimes makes its appearance? But whatever be the origin of smut, and other diseases to which wheat is subject, it seems to be a well established fact, that they are induced about the time of sudden changes of weather, when it seems probable that the functions of vegetation are enfeebled or interrupted; and it is also another well known fact, that plants, as well as animals, in a weak and languishing state, are most liable to become the habitation of parasitical beings, both of a vegetable and animal nature. The disease of smut is less frequent in a favourable season, when the growth is uniform and vigorous; and the steeping process, by which the disease is diminished or prevented, might be supposed to give a stimulus to the plant which remains, and enables it to resist alternations of heat and moisture through its whole existence. But although this may be the progress of the disease, it leads to no explanation of its origin.

Two species or varieties of smut are mentioned by some writers. In the one, the dust is contained in a pellicle or covering, forming balls which occupy the places of the grains in the ear. In the other, the form of the grain has entirely disappeared, and nothing remains but a few fibres of the husk or chaff, loaded with the black powder in a loose state, and without any covering. But it is more likely that it is the same disease, or the same fungus, in a more advanced period of its growth, when the ripened vesicles have burst, for the purpose of disseminating the plant.

Mildew is also a disease of wheat, which is supposed likewise to arise from a fungus of the same or of a similar nature. In mildew, sometimes the stem, and sometimes both the stem and the ear, are attacked, and the grain becomes small and shrivelled.

Blight is supposed to be an internal affection of the ear or spike of the wheat, which produces a total or partial deficiency of seeds, or, when the disease is less violent, renders the grains small and light. This disease is induced when heavy rains fall at the time when the wheat is in flower; but mildew succeeds heavy fogs or mists, or cold rainy weather, in the summer months, between the period of flowering and ripening. *Rust* is another disorder of wheat, in which an orange-coloured dust appears on the stem and leaves, and the plants become weak and languid. It is also ascribed to a vegetable parasite, and comes on in the time of excessive heat and unusual drought. *Red gum* is another disease, in which the chaff of the ear becomes of a deep orange colour.

Ripening of wheat.—In deciding on the proper time for cutting down wheat, the distinction between the ripeness of the grain and that of the straw must be attended to; for in some seasons the straw becomes yellow from the root upwards, indicating the appearance of ripeness, while the grain in the ear is soft and immature. It is considered of some advantage to cut down wheat before it is completely ripe, because it is apt to fall out of the ear during the harvest operations. But it should not be reaped in too green a state; for the grain shrivelling in drying injures its appearance, and the quantity of produce is diminished. The most proper time for reaping wheat and every kind of grain is, when that part of the stem which joins the ear affords no juice by expression. In that state, the grain which is clear skinned and fine, and the straw, are more valuable. When the harvest promises to be early, the crop may remain on the ground till it is more fully ripened; but in a late harvest, when winds and moist weather are apt to prevail, it may be cut down in a state of less maturity. Wheat fully ripe before cropping, is attended with inconvenience and loss during that operation; the ears break off from the stems; the grain drops from the husk, assumes a dark hue, which injures its appearance and quality in the market, and the flour from such wheat is of an inferior kind.

Harvesting.—In a dry season, and when the crop is free from succulent weeds, the wheat may be carried to the stack-yard in a few days after it is cut down; and when the straw is quite ripe at the time of reaping, it may be put upon the stack almost immediately from the sickle. By examining the joints of the straw of wheat or of other grains, a pretty correct judgment may be formed of the proper time of carrying them in. When they appear succulent and full of sap, some delay must take place; but if they are perfectly dry, no danger may be dreaded of stacking the grain; but if the crop be thrashed early, for seed or any other purpose, it must remain longer in the field, till it is thoroughly dry.

Another test, by which some husbandmen judge of the proper state of the grain for being carried to the barn-yard, is, by thrusting the hand into the centre of the sheaf; and if the sensation of cold be excited, the corn is considered as not sufficiently dry.

Stacking.—Omitting the description of putting up the grain in the form of stacks, and of covering and securing them from the weather, we shall only notice, that much advantage, both in saving the grain and preserving its quality, is derived from building the stacks on circular frames of timber, which are supported by feet of wood, stone, or cast-metal, and so constructed as to prevent the access of mice or rats, which often commit great depredations. They are also useful in obviating the injurious effects of damp grain, as a freer circulation of the air is admitted from below and through the whole rick, when a central funnel, or air-hole, is carried up while it is building. Round stacks, which are almost universal in Scotland, are considered preferable to those of an oblong form: although in the construction of the latter less time and labour are required, yet they are liable to the serious objection of interrupting the circulation of air in the barn-yard; of being more liable to injury in damp weather; and as they present a greater resistance to the wind, unless they are well secured, they are apt to be overturned.

Thrashing wheat.—The advantages of thrashing out grain, and particularly wheat, by means of machinery, have been already detailed in the description of the thrashing-mill. Even the produce of smutted wheat is cleaner, and in better condition, by the operation of the machine than by the *flail*; for it is less blackened during the operation, and, by careful dressing, the smut-balls may be completely separated, and the wheat sent to market in a clean state. When it is thrashed by the flail, it remains long on the damp barn-floor, during which the black powder attaches itself to the damp grains, and can only be removed by washing; but by means of the thrashing-machine all the operations are performed without interruption, and succeed each other so rapidly that the dry grains have no time to attract damp, and the whole of the black powder is easily separated, leaving the produce perfectly clean.

Produce.—The produce of a wheat crop must vary according to the nature of the season, and the fertility and condition of the soil. In Scotland, 40 bushels from the English acre are considered a large produce on fertile soils in good condition; but sometimes, in a favourable season, 47, and even 55 bushels have been obtained; from 24 to 30 bushels are regarded as a fair average crop on soils of a middle quality, under good cultivation; but when the produce is diminished to 18 bushels, the crop is considered scanty. In England, the produce, in some seasons, is under 20 bushels; while, on the same soil, and with the same culture, it exceeds 30 bushels in other seasons. The greatest produce of an acre in Middlesex, which has been recorded, amounted to 68 bushels; the smallest produce was diminished to 12. The average produce of Britain is supposed not to exceed 20 bushels from each acre.

2. *Rye.*

Rye may be raised on most kinds of land, but light and dry sandy soils, which are unsuitable for wheat or barley, seem to be most adapted to a crop of rye.

As poultry are less apt to attack rye than most other kinds of grain, it is thought most proper to be cultivated on those parts of the possession which are in the vicinity of the farm buildings; and in former times, when rye was an object of more frequent culture, it was not unusual to sow a ridge for the purpose of protecting the other crops from the depredations of domestic fowls. Rye may be raised after early field-turnips, clover, pease, and similar crops, and in some cases after clean fallows. As rye approaches nearly to the nature of wheat, it requires the land to be clean, and tolerably pulverized. When it is to stand for a crop, it is usual, in some places, to prepare the ground with some kind of fallow; but when fed off by sheep, a single ploughing only is given, for when the crop is sufficiently eaten down by the animals it is fallowed for turnips.

Time of sowing, &c.—There are two varieties of this grain, the winter and spring rye, or the black and white, or Dantzic rye. The winter rye is large, plump, and hardy, and is generally preferred. It is so hardy as to resist the effects of the severest weather. When intended for green food, it should be sown in August or September; but it succeeds by sowing it in October, and during any of the winter months, till the beginning of March. The quantity of seed, when a crop of grain is intended, from two to two and a half bushels is sufficient; but for green food three bushels, or even a larger proportion, may be employed. As rye germinates slowly, it is recommended to put it into the ground when it is in a dry condition, otherwise much of the seed is lost, particularly in a wet season.

After-management.—When the object of the crop is to afford a supply of green food for sheep in the early months of spring, no farther culture is required after it is put into the ground; but when a grain crop is expected, hand-hoeing and weeding ought to be carefully practised in the early stages of its growth.

The yellow colour of the stems, the drooping of the ears, and the hard, plump, and full condition of the grain, indicate the ripeness of the rye crop; and when the grain is free from weeds, and cut down in a dry season, it may be almost immediately carried to the stack-yard. Poor, sandy soils, on which rye is sometimes cultivated, yield but a scanty crop; on those of a better quality, the produce is from two to three quarters from the acre; but in the North-Riding of Yorkshire it amounts to three and sometimes to six quarters.

3. *Barley.*

Wet, heavy, and tenacious soils are unsuitable for the profitable culture of barley, which is to be considered as a tender and delicate plant. It succeeds best on sandy loams, or light and moderately dry soils; even light, poor soil, in a dry and warm situation, affords a crop of barley of superior quality to what is produced on strong lands of a cold and moist nature. Barley is usually cultivated after turnips, potatoes, beans, pease, or tares.

Preparation of the land.—Whatever be the crop which precedes barley, it is necessary that the soil should be reduced to a fine pulverized state, to insure an equal and perfect vegetation of the crop. This is effected by shallow ploughings and harrowings, and by occasional cross ploughing and rolling. In soils free from weeds, scuffling is recommended as a substitute for cross-ploughing; but in preparing the heavier kinds of land for barley, ploughing in autumn, and scarifying and scuffling, when the seed is put into the ground, are considered sufficient. When barley succeeds turnips, it has been long a practice in Suffolk to drill the seed without ploughing; but ploughing as early in the spring as possible, and giving a second ploughing immediately before the insertion of the seed, is pursued in Norfolk, where the barley crop on turnip fallow is generally well managed. When barley is sown after pulse crops, it is usual, in most districts, to give the first ploughing in autumn and the second in March.

Kinds of seed.—Different species of barley, and different varieties of these species, are cultivated in Britain. The two-rowed barley, *hordeum distichon* of Linnæus, includes several varieties, which have received different names in different places. These varieties are distinguished by the names of early and late, or *hot seed* and *cold seed*, from the circumstance of the former coming to maturity in a shorter period than the latter. Scotch barley, from being long cultivated in Scotland, belongs to the first, or quick growing variety. In the same variety is classed the *Rathripe*, or *Hotspur*, and *Sprat* barley, which is also known by the names of *Battledore*, *Fulham*, and *Putney* barley, because it is extensively cultivated in the vicinity of those places. The second species of barley in this country is the four-rowed, *hordeum vulgare*, or *tetrastichon*, which is well known by the name of *bear*, or *big*, or *rough bear*, in Scotland. This species, of which there are several varieties, answers well for elevated situations, late climates, and inferior soils. Six rowed barley, *hordeum hexastichon*, is a species which has a strong reed or straw, grows rapidly, and ripens early; is very hardy, and withstands the severity of winter, from which it is called *winter barley*. It is this species which is chiefly cultivated in Russia, and as far north as any grain is raised. It has seldom been an object of culture in Britain, although the trials which have been made were so satisfactory as to encourage their farther extension. In some cases, barley comes up irregularly, and ripens unequally. To obviate this inconvenience, steeping the grain is recommended, for the purpose of promoting the vegetation, and rendering the crop more uniform. The addition of a portion of soot to the water in which it is steeped is suggested for the destruction of insects. The best seed is of a pale bright appearance, without stain at the end, and full, plump, and well bodied.

Sowing barley, &c.—Barley, like wheat, is sown either broadcast or drilled, and it is recommended that the seed should be inserted immediately after ploughing, or on the *hot fur*, as it is called in Scotland, that is, while the turned up soil retains its moisture. In the southern districts of the kingdom, barley sowing begins about the latter end of February or the beginning of March; and in the northern parts the commencement is a month or six weeks later, and it continues to the middle of May, and even sometimes longer, according to the species or variety which is cultivated; but when the land is in good condition, early sowing of every kind of grain in the spring is always desireable, to insure the maturity of the crop. The quantity of seed varies from two to four bushels for the acre. A rich soil requires a smaller proportion of seed than such as is poor and exhausted; and a smaller quantity is allowed for an early than for a late sowing, because the plants have more time to tiller or push out side-shoots; but it seems to be generally recommended, that the allowance in all cases should be liberal.

After-management.—As land under a barley crop is frequently sown with clover and rye-grass, rolling is a necessary operation, to close the earth about the seeds of the latter, and it is no doubt useful, especially in porous soils, to the former. The barley crop often suffers much injury from the attacks of the worm. The sudden change from a rich green to a yellowish hue, indicates the commencement of the ravages of this insect. The use of a heavy roller, either to render the loose parts of the soil more compact, and prevent the access of the worm to the roots of the tender roots, or to destroy it by the pressure is beneficial. To produce this effect completely, the roller should be so loaded as to require the power of three or four horses. Top-dressing, before the application of the roller, is suggested as a useful practice to diminish the injury; and if it can be counteracted till genial showers of rain fall, no farther danger need be apprehended. When the barley is drilled, hand-hoeing is necessary, either before or after the insertion of the clover and grass-seeds. Hand-weeding has been seldom resorted to; but in some of the best cultivated districts in Scotland it has been successfully practised, and especially in fields which are infested with wild mustard and radish. When these plants have pushed out two rough leaves, the weeding should commence.

Harvesting barley.—The management of the barley crop in harvest requires more attention than any other kind of grain, even when the season is favourable; but in bad weather it is attended with great difficulty, and often with serious loss. When barley is fully ripe, the straw becomes very brittle, so that the heads are exceedingly apt to break off in handling. It is therefore recommended to cut down the barley crop while the grain retains some degree of softness and the straw contains a portion of its sap. This circumstance renders the succeeding operations of drying in the field, and of stacking, a business of some nicety. On this account it must remain long in the field, to dry and harden, so that it is exposed to all the changes of the weather; and, on the other hand, if carried too soon to the barn-yard, the risk of heating in the stack is considerable.

Barley is cut down in the usual manner with the sickle, and sometimes with the naked scythe, or with the aid of a bow, to assist in laying the grain one way. When it has remained in the swath till it is dry, it is bound into sheaves, and stooked. This should not be delayed after it is dry, when the straw becomes brittle. Barley is stacked in the same way as other grain; but it seems to be more necessary to observe every precaution in avoiding the risk of heating, and for this purpose it is not unusual to leave a hole or funnel in the centre of the barley rick, from top to bottom, to allow a free circulation of air. With this view, open frames, or central bosses, are employed; but when such artificial apparatus is wanting, a bundle of straw is placed in the middle of the stack at its commencement, and as the building proceeds the straw is drawn upwards, and leaves an opening behind; and if communications with this central opening have been formed from different sides of the stack, a free current of air is admitted, which prevents both mustiness and heating.

Barley is thrashed in the same manner as other grain. Some difficulty attends the separation of the awns from the grain, which is effected sometimes by an additional apparatus to the thrashing-mill—sometimes by frequently passing it through the thrashing-mill itself—by the use of the flail—or by stamping with an implement, the extremity of which is covered with plate-iron, made like a honey-comb—or by a machine which has been lately invented, and which seems to answer the purpose most effectually.

Produce.—The produce of this grain varies according to the condition of the soil, the climate, and the kind of culture employed. The average produce of the whole kingdom is stated at from 27 to 30 bushels the acre. The average produce in Middlesex, and the turnip-lands in Yorkshire, is about 32 bushels; but in many other districts it does not exceed 28 bushels. The extremes of the produce of the barley crop are from 12 bushels, which must be considered a very poor one, to 50, and sometimes even 60; but in good soils, and favourable seasons, from 30 to 42 bushels may be estimated fair average crops.

4. *Oats.*

This kind of grain is of a hardy character, and may be raised upon almost every kind of soil; but the most abundant crops may be expected from strong, rich soils, which have been lately broken up from the state of grass; and on land of a cold, tenacious, and fenny description, the oat is preferable to any other kind of grain. Oats succeed well after all kinds of green and root crops.

Preparation of the land.—When oats succeed tares, early pease, and some other crops which are removed from the ground early in the summer, on soils which are too wet for being ploughed in the winter, a clean bastard fallow, and laying the land up into ridges, are recommended as the best preparation for early sowing in the spring. When grass lands are broken up for oats, a ploughing is given, commonly in January, that a stiff soil may be rendered friable by the frost. When wheat or barley is the preceding crop, it is usual to plough in the spring, and particularly in those cases where grass-seeds are sown. It is generally found that grass-lands afford the most abundant crop of oats. As they are a hardy grain, and affording a tolerable crop on every kind of soil which is not excessively exhausted, this has probably given origin to the careless manner in which the land is often prepared for the reception of this corn, and which has been

Arable land.

justly reprobated by intelligent agriculturists. It has been observed, that "in all cases it is a good practice to have the land in a fine state for the growth of this crop, which is best effected in the same way as for barley. It is perfectly absurd to suppose that it will not be equally profitable to the farmer to have the land in as good a state of preparation for this sort of crop as that of barley." In some districts ribb-furrowing, or slob-furrowing, which is performed by turning over the furrows at the distance from 12 to 18 inches on the unbroken land, by which the surface is exposed, the soil improved, and the root-weeds destroyed, is practised in the autumn; the harrow is applied in the spring, and a complete ploughing is given before the insertion of the seed. By this management, even stiff and heavy land is brought to an excellent condition for this kind of crop. It cannot, indeed, be doubted, that a fuller and more complete preparation of the soil than is usually given to the land for a crop of oats, would not only increase the quantity, but greatly improve the quality.

Kinds of seed.—The numerous varieties of oats, which have arisen from diversity of soil, climate, and culture, are referred to the same species, *avena sativa* of Linnæus. These varieties, which have received their names from the places where they have been selected or cultivated, are estimated according to the produce of grain or straw, the proportion of meal which they afford, and the peculiar property which they possess of arriving at maturity within a shorter or longer period. The *white* oat includes under it varieties, some of which ripen early and others late. Of the early kinds, the *Blainslie* oat has been long in reputation in Scotland, and answers for elevated and late situations. The *Angus* oat ripens late, yields an abundant produce, affords a sweet meal, and is well adapted to soils of an inferior quality. The *common* oat has been long cultivated, yields a large produce of grain and straw on good soils, and grows well on those of a poorer description, and as it ripens early answers well for a late situation. The *Poland* oat is a plump variety, ripens early, produces a large crop on a rich soil, and brings a high price in the market; but the quantity of straw is small, and it sustains great injury from shaking winds. *Church's* oat, a plump, heavy, and productive variety, which was long in great estimation on the richer lands on the banks of the Tweed, belongs to the Poland oat. The *Frieseland* or *Dutch* oat has a thin-skinned grain, and yields a large proportion of straw; is suitable for the better kinds of land, and is not ill adapted to weaker soils in sheltered situations. The grains of the *Siberian* or *Tartarian* oat are thin and small, and the largest are awned; the straw is tall and reedy, which renders it less fit for the purpose of fodder: but as it is of a hardy character, it may be raised on inferior soils. The *red* oat, so called from the reddish colour of the husks, was either selected or first cultivated on the estate of Magbie-hill, in Peebles-shire in Scotland, from which it has been denominated *Magbie-hill oat.* The grains are small, but the husks are thin, and the produce of meal is abundant. It ripens early, resists the force of the wind better than other varieties, and succeeds well in high and cold situations. But the potatoe-oat, which was discovered in Cumberland in 1788, and was afterwards introduced into Scotland, is now the prevailing variety on well cultivated soils in the northern and some other districts of the kingdom. On all deep and tender loamy soils, which have been broken up from grass, the potatoe-oat yields the largest produce both of grain and meal; but in soils of a shallow description the quantity of straw is less than from some other varieties. The record of the average prices of oats in Marklane, on the 16th October 1811, exhibits the most decided proof of the superiority of the potatoe-oat; for while the common kind of oat brought 32s. and the Poland oat 40s. the average price of the potatoe-oats was at 42s. the quarter. Potatoe-oats tiller more freely, and succeed better on soils where the Poland variety would scarcely defray the expense of harvest labour. Indeed, such is the superiority of the potatoe-oat, both with regard to its abundant produce in grain and meal, at least when it is raised in less elevated situations, that it is now generally preferred to every other variety. But it ought to be mentioned, that some degree of degeneracy is observed in this valuable variety of oats, in certain districts. The grains have become long and thin, the skin has increased in thickness, and sometimes the appearance of the protrusion of an awn is traced,—circumstances which indicate the necessity of attention to select the strongest growing ears, and the best formed grain for seed. It is worthy of notice, that the person who first introduced potatoe-oats derived considerable emolument from the growth and sale of that variety; but he was extremely careful in separating the small grain, and selling only the full, large, and perfect grains, for the purpose of seed, which always brought a high price.

Sowing, &c.—In the southern parts of the kingdom, oats are generally sown in the month of March, often in the end of February, and in some instances have succeeded well early in January. In the northern districts, the time of sowing oats is from the middle of March to the end of April; but, in general, early sowing, for the purpose of establishing the crop before the approach of warm weather, especially on dry and parching soils, as well as to afford a better chance of the young plants escaping the ravages of the worm, and to insure an early crop, ought never to be omitted.

Oats are generally sown broadcast, and the quantity of the seed varies from four to five bushels the acre. When the sowing is early, the smaller proportion is considered sufficient, but when it is later the larger proportion is necessary. The Poland variety requires a larger quantity of seed than the potatoe-oats. Sometimes larger proportions of this grain are allowed for seed. Eight bushels to the acre have been sown in Lincolnshire, and have afforded a better and more equal crop than with a smaller quantity, besides the advantage of ripening four or five days sooner than with thinner sowing. Oats have been more rarely drilled than other kinds of grain; but where this method has been practised its benefits have been obvious, and in such cases five bushels of seed to the acre have been employed.

When clover and grass seeds are sown with oats, they are covered in by a slight harrowing; and in light and friable soils the application of the roller, as soon as possible, is useful; but in other kinds of soil, it is better to defer this operation till the crop be advanced a few inches in height. The only other culture necessary for a crop of oats is, to keep it free from weeds by means of hand-weeding.

Harvesting.—When the straw appears of a yellowish hue, the grain becomes hard, and the husks open, oats are ready to be cut down; but as the earlier varieties are apt to shed the seed during the harvest operations, they require to be reaped before they are fully ripe; yet the precaution not to cut too green must be observed, for the produce is greatly diminished in quantity and quality. But, upon the whole, oats are a grain of a hardy character, and suffer less injury during harvest than other crops. The operations of stacking, thrashing, and preparing oats for the market, are similar to those already described.

Produce.—The produce of oats is extremely various in different soils, seasons, and situations. The particular kind which is cultivated, as being more or less fitted for the soil and situation, occasions considerable diversity in the amount of the produce. The quantity from an acre varies from 20 bushels, or even less, to 70 or 80. The value of the bushel of oats is to be estimated according to the proportion of meal which it affords. An opinion is prevalent, that oats are generally a more productive crop in the northern than in the southern districts of the kingdom; and it is also asserted that the grain is of a superior quality. Some writers have entered into speculations concerning the causes of this difference, without being at the trouble of ascertaining how far the fact is to be considered as established.

5. *Beans.*

Beans may be successfully cultivated on the strongest kinds of moist soils. They thrive equally well on stiff, clay land, and that of a loamy nature; but they succeed best on soil of a good depth. Bean crops are raised after wheat, oats, and clover, and newly broken-up grass lands. This crop is peculiarly adapted to ley grounds, where injury to the corn crop, from the attacks of the grubs or other insects, is apprehended. This kind of crop is also beneficial in breaking down and reducing the soil, and in promoting the decay of the grassy material and destruction of weeds by its shade.

Preparation of the land.—In some districts, a single ploughing, at the time of inserting the seed in spring, is all the preparation which is made for the reception of the bean crop; but it is a preferable practice to lay up the lands in narrow ridgelets early in the autumn. Some writers recommend the previous application of manure, when beans succeed a grain crop, as wheat, by which the strong and vigorous growth of the lateral shoots is promoted. In such cases the land should be ploughed into that form which is most commodious for the method of sowing to be adopted, as, in drilling, to suit the breadth of the drilling machine, and, in dibbling, to facilitate the operation of the scuffler or scarifier. This mode of ridging is peculiarly beneficial in heavy soils; the manure is retained in the middle of the ridge, and secured from being washed off in heavy rains; and the soil is in a dry state and in good condition for the reception of the seed in the spring. It is scarcely necessary to mention, that water-furrowing, after the ploughing in autumn, should on no account be omitted.

Kinds of seed.—In the vicinity of large towns, some varieties of the garden-bean are cultivated in the field, for the purpose of supplying the market with the produce in the green state; such as the mazagan, an early kind, the mumford, the long pod, and the Windsor; but the horse-bean is most generally admitted into field culture. The tick-bean is supposed by some to afford the most abundant crop. The large ticks are chiefly raised in Kent; but in Essex the small ticks are preferred on strong soils, because they afford the largest produce, and bring the highest price in the market.

Sowing, &c.—The bean-crop may be inserted as early as the month of January in sheltered places, and in the succeeding month in more exposed situations in the southern districts; but in the northern parts of the kingdom the month of March may be found a more suitable season for this purpose. The quantity of seed is from three and a-half to four bushels to the English acre.

The broadcast method of sowing beans is now rarely practised. For as this is one of the best fallow crops to precede wheat, the drill husbandry is most advantageously pursued; and, to have the full benefit of horse-hoeing, the drills should not be nearer than 27 inches. It appears from experiments made to ascertain this point, that such a distance between the drills affords the largest produce. The drills are formed by the plough; the seed is deposited by the drill-barrow; the intervals between the furrows are split up to cover the seed; and 10 or 12 days afterwards the field is levelled by cross-harrowing. But if the season or the soil render this mode of drilling impracticable, a spring furrow only is given; the drill machine follows every third plough, and the operation of harrowing concludes the business. The depth to which beans should be planted, is recommended to be about five or six inches. In the southern districts, it is the practice to dibble beans in rows a foot distant, and each seed two inches apart in the row. This method is expensive; but it admits of the land being well cleaned. In Essex, beans are dibbled on two-bout ridges, three feet broad, and in double rows on the crowns nine inches apart, with an interval of 27 inches. The bush, or short-tined harrow, is drawn over the surface to cover the seed.

After-culture.—The operations of hand or horse-hoeing, as the distance between the rows admits, are essentially requisite, not only for the luxuriant growth of the bean crop, but also as preparatory for the succeeding crop of wheat. When the plants have been 10 or 12 days above ground, the surface between the rows is scraped, for the purpose of loosening the weeds; and after the lapse of a few days, according to the state of the weather, a small light plough may be employed to remove the earth from the sides of the rows; the weeds in the rows are to be drawn out by the hand, after which the plants are earthed up, by the double mould-board plough. The same operations are to be repeated every fortnight or three weeks, or as often as shall be found necessary, till the crop come into blossom, when the earth should be carefully drawn to the roots of the plants, to promote the setting and filling of the pods.

The black, or dolphin fly, is exceedingly destructive to the bean crop in dry summers. To prevent its ravages, the tops on which it first settles are cut off with the scythe or some sharp instrument. In June or July, when cold nights succeed hot and foggy weather in the day, beans are liable to injury from blight, which causes the blossoms to fall off; but sometimes a second bloom appears, and affords a tolerable crop.

Harvesting.—The blackening of the pods indicates the approach of the bean crop to maturity; after which the pods open at the extremities, and the seed is apt to drop out; but before this happen, the beans should be cut down, to prevent the risk of loss. At the same time, it ought to be recollected, that the crop is in no small degree diminished in value and quantity when it is cut before it has reached a proper state of ripeness.

Beans are either cut with the sickle or scythe, or drawn up by the roots; the sheaves are left untied for some days, to dry slowly; they are bound up with woollen yarn, old ropes, straw ropes, or ropes of the pease sown along with them, and three or four sheaves are set up together. In stacking beans, the precautions already mentioned should be observed, especially in forming an opening in the centre of the rick, for the admission of air.

Produce.—The produce of the bean crop is stated at 28 and 32 bushels from the acre, in Middlesex; in Kent, 48 bushels of the common tick bean are obtained from the acre of good land; in Yorkshire the produce is nearly the same; and through the kingdom it varies from 16 to 40 bushels. The straw is not only useful as litter for horses and other animals, when it is well broken by thrashing, but also affords a nutritious food both for horses and cattle through the winter. For this purpose, it is considered little inferior to hay, particularly when mixed with pease straw.

6. *Pease.*

Pease are sometimes sown along with beans, and sometimes with oats, for the purpose of supporting their weak trailing stems; but the unequal growth and ripening of the different plants probably diminish the value of both crops. Pease succeed on almost all soils; but the best crops are obtained from those of a light dry description, in tolerable condition, and having a proportion of calcareous matter in their composition, without which, experience has shewn, the crop runs to straw, and the pods are imperfectly filled and ripened.

Pease succeed wheat, oats, and other grain crops, as well as clover or sainfoin, and are an advantageous crop on old ley grounds which are newly broken up, where the ravages of the worm are destructive to other crops. The more tenacious soils require a ploughing in autumn, as a preparation for the scarifier and scuffler in the spring. The soilshould be in a reduced and pulverized state, and a compost of earth, dung, and lime, is recommended by some, while others consider the application of manure as not only unnecessary, but injurious, in producing a luxuriant growth of straw, which is unfavourable to the podding, and encouraging weeds, which, from the nature of the crop, are with difficulty eradicated.

Kinds of seed.—Numerous varieties of pease are in cultivation. They have been divided into the early and the late kinds; among the former are the early *Charleton*, the *golden hotspur*, and the *common white pea*, which are usually cultivated in the southern districts, and in the neighbourhood of large towns, to be sold in a green state. The late pease include the varieties of the grey kind, which are more generally employed for field culture.

Sowing, &c.—Those varieties which are intended for the market in the green state, are sown in succession, with intervals of ten days or a fortnight, from the middle of January to the end of March. Sometimes the seed is sown in autumn; but it is a doubtful practice, except on a rich soil, in a warm and sheltered situation. For this purpose, the hardy *hog pea* should be selected; but for general crops, the grey sorts are preferred, and are sown as early in March as the condition of the soil admits. For general sowing, on land in tolerable condition, from 3 to $3\frac{1}{2}$ bushels of seed is a sufficient quantity to the acre. When sown early, a larger proportion is required. Broadcast sowing is sometimes practised; but drilling, as it facilitates the operations of cleaning the land from weeds, should be preferred. For hand-hoeing, the distance between the rows is from 12 to 16 inches; but when horse-hoeing is to be practised, the distance should be from 24 to 30 inches; the depth at which the seed is deposited is from two to three inches. In Norfolk, pease are drilled at nine inches distance; and when they are dibbled, two rows are planted on a flag, so that the distance is not more than four inches. In some districts, the drills are transverse and at 15 inches distant, and the seed is covered in by the hoe or bush-harrowing. Steeping the seed before sowing is rarely practised; but it seems to be useful in promoting the vegetation, and rendering the growth more vigorous and uniform.

After-culture.—When the width of the intervals is such as to admit of horse-hoeing, the first operation is to remove the earth from the rows, and afterwards to lay it up by splitting the intervals; but when hand-hoeing only is admissible, two applications are requisite; the first, when the plants are two or three inches high, and the second before they come into blossom. In the last hand-hoeing, the ground is well cleared of weeds, and the rows being laid down the earth is carefully drawn to the roots.

Harvesting.—Pease are reaped or cut up by means of a hook with a sharp edge, and collected into small heaps, which are set up against each other for drying. The early crops are put into loose open heaps, and when they are perfectly dry, are formed into stacks, to be employed as the food of animals. When pease-straw is intended for horses, it is recommended to cut it into chaff, and mix it with their other food. The pease which are not consumed as human food, are employed in fattening hogs, and other domestic

Arable land.

animals, and sometimes they are used as a substitute for beans in feeding horses; but as they are apt to produce gripes in the green state, they should not be given till they are sufficiently dry.

Produce.—The produce of pease is estimated by some at 28 or 32 bushels from the acre, while others suppose that the average of any two crops does not exceed 12 bushels. This crop, therefore, considering its direct value, is less profitable than many others; so that its ultimate advantage must be sought for in the improvement of the soil.

7. *Tares.*

Tares succeed best on gravelly loams, which are not too moist; but they produce a tolerable crop on almost every variety of soil, from the thin gravelly to that of a deep, stiff, and clayey description. After winter crops, tares are sometimes sown with a single ploughing, but two ploughings, with an intermediate harrowing, is considered a better practice; and when the soil is not rich, the crop is greatly improved by manuring. Tares usually succeed a crop of wheat or barley.

Kind of seed.—Two varieties of the tare, belonging to the same species, *vicia sativa*, are cultivated, and distinguished by the names of *winter* and *spring tare*, of which the latter is less hardy in its habits; and although it is difficult to discriminate the seeds of these varieties, they should always be kept separate, for the seed of the spring tare is unsuitable for the winter crop, and the seeds of the winter tare should not be employed for the summer produce. The difference is easily known when the plant springs up. The seed-leaf of the winter tare is of a fresh green colour, but the spring tare comes up with a grassy spear of a brown dusky hue.

In broad-cast sowing, the quantity of seed employed to the acre is from $2\frac{1}{2}$ to 3 bushels. In drilling, at the distance of six inches, 2 bushels are considered sufficient; but when the crop is to be cut for soiling, a larger proportion is allowed.

Time of sowing, &c.—Winter tares are sown from August to October; earlier on poor soils and exposed situations than in richer soils and more sheltered lands. The plants should be established in the soil before the approach of the cold season. The spring variety is sown from the end of February to the beginning of April, when it is intended to ripen the seeds; but when the crop is to be employed as green food, from the beginning of April to the end of May is a proper time for the insertion of the seed. Sometimes spring tares are sown in June, with a quart of cole seed to each acre, for the purpose of supplying weaned lambs in autumn with an excellent food. This method is successfully practised on the Down lands in Sussex.

Tares are usually sown broad-cast; and it is necessary to distribute the seed as equally as possible over the surface, and to cover it well by harrowing, to prevent the depredations of birds, and insure a perfect and uniform vegetation. Drilling, as it is practised in some of the southern districts, is recommended on all rich clean soils for this kind of crop. The distance between the rows is from six to eight inches.

After-culture.—Less attention than to most other crops is required in the management of tares, because the plants soon cover the land; but hoeing and weeding, which should be performed early in the spring, are undoubtedly beneficial. A light roller passed over the crop in the early spring months, when the season is dry, smooths the surface, and renders it fitter for the operation of the scythe.

Harvesting.—Tares are managed in the same way as pease, when they run to seed, and are preserved for that purpose. When tares are made into hay, the time of cutting is when the blossoms have declined, and begin to fall flat. The hay from tares is of a nutritious quality; but as it requires much sun and air to dry it thoroughly, and as it is very apt to be injured by moisture, it is more troublesome in its preparation than most artificial grasses.

Produce.—The produce of green tares has amounted to 12 tons from the acre in Middlesex, and when converted into hay to about three tons. The produce in seed from the acre has sometimes exceeded 40 bushels.

The most beneficial application of the tare crop is soiling with horses or other live-stock on the farm; but for this purpose it ought not to be cut down at too early a period. Eating tares in the field, by turning live-stock into it, is considered an improper practice, as it is not only destructive to the crop, but injurious to the soil. The tare crop is considered of such importance in Sussex, that a much larger proportion of stock is supported. All kinds of animals thrive upon it. A single acre of tares has maintained four horses in better condition than five acres of grass; and without any other food, twelve horses and eight cows have been kept for three months upon 8 acres of tares. The milk of cows fed with this plant is so much improved that it yields a greater proportion of butter.

Some other species of *vicia* are recommended as worthy of the attention of the agriculturist; as, the *bush vetch*, *vicia sepium*, which shoots early in the spring, vegetates late in autumn, continues green all winter, is supposed to be a valuable pasture plant, and no fertile soils might be converted into hay; and the *tufted vetch*, *vicia cracca*, which rises to a considerable height, and affords abundant foliage, so that it might likewise be used as green fodder, or preserved for hay. Poor lean cattle have been greatly improved by feeding on this plant. The everlasting pea, *lathyrus latifolius*, is a plant of large growth and foliage, is also recommended for the purpose of green food, or for hay, and is of a nutritious and fattening quality. *Chicory*, or *wild succory*, *cichorium intybus*, is a succulent, herbaceous plant, which is also employed as green food for different kinds of live stock. *Buck wheat*, *polygonum fagopyrum*, is sometimes cultivated for the same purpose.

8. *Potatoes.*

It is a curious fact in the history of the vegetable kingdom, that the potatoe, *solanum tuberosum* of Linnæus, the native of a warm climate, should be naturalised and extensively cultivated in northern regions, on account of its valuable properties, as an essential article of human food. The precise period of

Arable land.

the introduction of this root into this country is not distinctly ascertained; but it was known in England previous to the year 1597, as appears from the description of Gerard, in his History of Plants, printed in that year. He speaks of two kinds, the common and the Virginia potatoe, which he cultivated in the garden. It is not less curious to observe, that the long period of a century and a half elapsed before the cultivation of the potatoe became pretty general. The diversity of soil, situation and culture, to which the potatoe has been subject for great part of an hundred years, has given rise to numerous varieties, which are chiefly characterised by the quality of the root, quantity of produce, and period of ripening.

All the varieties of the potatoe have been included under two divisions, distinguished by the colour of the flower and the root; as, the red-rooted, which produces a purple flower, and the white-rooted, which bears a white flower. In Lancashire, where the culture of the potatoe is well understood, and extensively practised, more than twenty varieties of the early, and fifteen of the late kind, have been enumerated. In reference to the potatoes cultivated in England, it may be observed, that the old *winter-red* is regarded as an excellent variety for the table in spring, and is said to be less liable than others to the curl. The black potatoe is also a late kind, and keeps well till August. The *white* and *apple* varieties are best adapted for use in the early part of the season. The *royal*, or *Cumberland* early, is of a good flavour, and grows to a large size, ripens early, and affords an abundant produce. The *ox-noble* and the *cluster* potatoe, are the varieties chiefly cultivated as food for live stock, because they are very productive and large in size. The varieties of the potatoe which are in common use for the table in Scotland, are the *round white*, the *white* or *yellow kidney*, the *red*, *purple*, *streaked*, or *black*, which last is best fitted for being used in spring and the beginning of summer: the *white bloom*, *yam*, or *Surinam* potatoe, from its large size, and great produce, is chiefly cultivated as food for cattle.

New varieties obtained.—New varieties of this invaluable root are obtained by raising it from seed, by which the quality and productive powers of the plant may be greatly improved. When the potatoe apples come to maturity, and begin to fall spontaneously, they are collected and preserved among sand till the spring, when they are bruised among the sand, or among fresh mould, and the seeds are separated, and mixed equally with the mould or sand. They are then sown on well prepared, fine garden earth; and as the rough leaf appears, and the plants have sufficient strength to be safely handled, they are transplanted into another bed of fresh mould, in rows, and are to be kept clean during the summer. In autumn, clusters of small potatoes, of different sizes, are found at the roots; these are planted in the succeeding spring, and produce larger potatoes, but they do not reach their full size till the third or fourth year. When a moderate artificial heat or shelter, as that of a stove or garden frame, can be procured, the seeds may be sown earlier, so that they shall be ready for planting out as soon as the weather permits; and in this way the process is greatly shortened, for the roots are larger the first year, and attain nearly their full size in the second season. The quality of the potatoe, and its productive property, as they are more or less combined in the same plant, determine the choice in selecting the varieties of seedling potatoes which are to be preferred.

Soil and preparation.—The soil best adapted for the culture of potatoes is of a rich loamy description; but they are successfully cultivated, and the largest produce has been obtained on stronger kinds of soil. Excellent potatoe crops have been raised on mossy soils.

In preparing the land for potatoes, it is usual, in most districts where this root is much cultivated, to give the land one or two ploughings in the end of autumn; and in the spring, at the time of planting, to reduce the cloddy surface, and to bring it into good condition for the reception of the sets by the operation of the harrow. Sometimes the land is ploughed up about Christmas, and again in the middle of April; and with intermediate harrowing and rolling, it is brought into a proper state to be ridged up and planted.

Manuring.—Manure is almost invariably applied in the culture of potatoes, and it would appear, from experiments with different kinds, that the most abundant produce follows the use of farm-yard dung; but besides street-manure, which is extensively employed in the culture of this crop in the neighbourhood of large towns, various other matters, as wheat-straw, furze, broom, and similar plants, succulent plants, as clover, tares, and vetches, and peaty or turfy substances, have been successfully employed in the same way. On the sea-coasts, in the northern parts of the island, sea-weed has been found useful for the same purpose.

It seems to be generally understood, that a liberal allowance of manure is necessary to insure a good crop of potatoes. According to Mr Billingsley, 20 cart-loads, each of the capacity of 30 bushels, should be applied to the acre; and Mr Young recommends from 25 to 35 cubical yards, and where it is long or littery, to the amount of 40 cubical yards to the same extent of ground.

When the potatoes are drilled, the manure is equally distributed in the bottom of the drills; but for raising the early kind of potatoes, the application of manure to the preceding crop is thought by some to be a better practice; for in this way the excessive luxuriance of the stems and leaves is checked, the size of the root becomes larger, and its quality is improved. Mr Dickson of Bangholm, near Edinburgh, ploughs in the manure for the succeeding potatoe crop, with a furrow of seven or eight inches, in November or December; the land is cross-ploughed, about the 1st of March, with a furrow of 12 or 14 inches deep, and afterwards prepared for drilling. This method of applying the manure admits of the crop being planted earlier on lands which are of a soft and wet nature, and would not admit loaded carts, without injury, till a late period of the season; but, for early potatoes, he finds it the best practice to insert the manure in the drills.

Time of planting.—Potatoes are planted as soon as possible after the danger of frost is over, which, in the southern parts of the kingdom, is from the mid-

Arable land.

dle of March to the end of April; but, in the northern districts, the commencement and termination of the planting season are at least a month later. Early planting, during dry weather, always insures an earlier and more abundant crop, as well as of better quality.

Seed.—The selection of the varieties of potatoes to be planted depends on the object of the cultivator, whether it be intended to have an early or late crop, or whether it be destined for human food or for the support of live-stock; but whatever variety is preferred, it has been recommended that the seed potatoes should be taken from the finest and most perfect of their kinds, in which the eyes or buds being stronger, produce stronger and more vigorous plants, and afford a larger produce. Very extensive experience has amply proved, that the cultivation of the same kind of potato, for a continued succession of crops, in the same soil and situation, injures the quality, as well as diminishes the quantity of the produce. In those districts where the culture of the potatoe is practised according to the most improved methods, attention to the frequent change of seed is never neglected. The farmers in the neighbourhood of Edinburgh, who raise great quantities of this root, find, from experience, that the amount of produce, and quality of the crop, are most improved the second year after a change of seed; and proceeding upon this fact, they introduce such a quantity of a proper kind of seed, and from a suitable distance, as, being planted the first year, shall yield sufficient seed for their whole crop in the succeeding season. By this management, the curl is entirely prevented, the quality is improved, and the crop is abundant.

From numerous experiments on the comparative advantages of planting entire potatoes of a larger or smaller size, cuttings of different sizes, with one or more eyes, or shoots only, it appears that middle-sized whole potatoes, or large cuttings of large potatoes, uniformly afforded more productive crops than smaller potatoes entire, or small cuttings, or the eyes or shoots alone. Considerable diversity in the amount of the produce was observed in varying the distance of the sets in the rows from six to twelve inches. With the view of saving seed in times of scarcity, the shoots only are employed; but this saving is counter-balanced by many disadvantages. The shoots cannot be planted so early; many of them being weak afford little or no produce, and the crop is generally later in reaching maturity. In the use of the eye, or root-bud of the potatoe, the success of the crop has been various. In some cases, the produce seems to have been equal to what was obtained from larger sets, but in others, feeble plants, and a diminished crop, have been the certain consequence of this kind of seed. The quantity of seed or sets employed varies according to the distance between the rows and the space between each set in the row. When the sets are planted at 10 inches distance in every direction, each acre requires from 25 to 30 bushels; and when every other furrow is planted at the distance of a foot between each set, from eight to 12 bushels are sufficient.

Methods of planting.—On moist soils, intended for a potatoe crop, and under a damp climate, it is recommended to raise the land into one-bout ridges, which preclude the danger of injury from stagnant water; but dry and sandy grounds should be kept flat. In Lancashire, where the potatoe culture is well practised, drills are formed at equal distances, and of such width and depth as to contain the manure. The distance of the drills is such, that the horse which leads out the manure may pass in one furrow, and each of the wheels of the cart in others, on the different sides. The manure is equally distributed in the three furrows, by means of a crooked fork with two or three prongs. The distance of the drills is usually from 28 inches to three feet; the richer and more fertile soils require the largest space. The sets are placed upon the dung, and the plough is run along both sides of each drill, to cover the seed.

In some districts, where the soil is dry, the manure is equally spread over the surface of the ground, which has been well prepared by twice ploughing and harrowing. The sets are planted in every third furrow, and the dung and mould are turned down upon them by the plough. In this way a level surface is preserved, and the dissipation of moisture is prevented; but it can only be pursued where manure is abundant.

The method recommended for planting potatoes upon sward land is, after preparation by the use of a plough which pares off the surface, and deposits it in the furrow, to place the sets on the inverted sods, at the proper distance, and to cover them with mould from below, by a common plough. This method, in which the decay and decomposition of the turfy matters answer the purpose of manure, may be useful where it is scarce, or in bringing waste lands to the state of tillage.

In what is called the *lazy-bed* method of planting potatoes, the spade is employed. The land is formed into beds of six or seven feet broad, and three or four feet are left on each side for trenches. The surface of the bed is slightly dug over, the manure is equally spread, the sets are planted at the proper distances, and they are covered to the depth of three or four inches, with the mould dug from the side trenches. On retentive soils of considerable depth, good crops have been obtained by this method of planting; but it is less adapted to the thinner and poorer kinds of soil.

Dibbling is another method which is sometimes practised in planting potatoes; but in a comparative estimate of this method with the system of drilling, the superiority of the latter, in affording an earlier crop, and more abundant produce from the same kind of soil, and treated in the same manner, is very remarkable. But in whatever way the sets are inserted in the ground, the precaution of not planting them at too great a depth, and of covering them with fine friable mould, should be strictly observed. The depth of four or five inches is considered sufficient in dry soils; but a less depth may be necessary where the ground is moist and of a strong quality.

After-management.—The luxuriance and abundance of the potatoe crop depend greatly on the attention and industry which are employed in the cleaning and hoeing operations. It is recommended by some to harrow the land when the shoots from the sets un-

Arable land.

der the surface have advanced about an inch, which is to be ascertained by examination. By the operation of harrowing, the surface of the soil is not only cleaned from weeds, but loosened, to allow the tender shoots to push freely through it. A small folding harrow is recommended for this purpose, by which the weeds are destroyed, and the mould is applied to the opposite sides of the contiguous rows. When the potatoes are entirely up, the earth and weeds may be removed from them, by forming a shallow furrow with a small plough. The same operation is repeated after the lapse of a few days, and when the weeds, which are in this way covered up in the intervals, have decayed, the earth is returned to the plants by means of a double mould-boarded plough, which passes twice in the same track, and turns a slight furrow to each side. When the plants have reached the height of about six inches, the earth is raised still higher with the same implement. When it appears necessary, hand-weeding and hand-hoeing, to complete what is deficient in the operation of the plough, must not be omitted during the growth of the potatoe crop.

Curl in potatoes.—The disease called *curl*, which was first observed in Lancashire about the year 1778, soon spread very rapidly, especially in those districts where the culture of this valuable root was most extensive, and excited by its ravages no inconsiderable alarm that the country might be deprived of a very essential article of food. This, as might be expected, has been a fertile subject of discussion and speculation among agricultural writers. It would afford no useful information to enter into a detail of the causes to which the curl has been ascribed, or of the numerous and contradictory opinions which have been held concerning its origin.

The result of some experiments instituted by Mr Thomas Dickson, of the Broughton nurseries, near Edinburgh, and communicated to the Caledonian Horticultural Society, seems to prove, in a very satisfactory manner, that this disease in potatoes is owing to the plants or sets being taken from potatoes which are too ripe. This was first suggested by Sir George Buchan Hepburn, Bart.

In the autumn of 1800, Mr Dickson selected 14 pounds of a long flat potatoe, which he procured from Fifeshire, and he took one or two sets from each end of each potatoe, that is, from the extreme or wet end, and from the umbilical or dry end, next the connecting radicle. The sets from the different ends of the potatoe, were planted on the 27th April 1801, with the same quantity of manure, and in the same circumstances. In the end of June, all the plants from the wet, or least ripened end of the potatoe, had come up, and looked healthy, excepting three, which were slightly affected with the disease. These were thrown out, and such only as were quite free from it were preserved. Few of the plants from the dry, or ripest end of the potatoe, had appeared, and such as had sprung up were all in a greater or less degree diseased. In many instances the sets had not vegetated, and when the new crop was dug up, they were nearly as fresh as when put into the ground. The produce of both sorts was taken up on the 3d of October, and pitted, for repeating the experiment, which was prosecuted in the same way for 1802 and 1803. The results were invariably the same. The plants from the unripened ends continued healthy, and produced abundant crops, while those from the dry ends continued to degenerate. It ought to be observed, that the produce of the curled potatoes was taken up before being too ripe, and replanted with the others. The disease was not removed, but it was not aggravated. Mr Dickson recommends some rules, the observance of which may entirely banish the disease of curl from the country.

Arable land.

1. To procure a sound healthy seed-stock, which cannot be relied on unless obtained from a part of the high country, where, from the climate and other circumstances, the tubers are never over-ripened.

2. To plant such potatoes as are intended to supply seed-stock for the ensuing season, at least a fortnight later than those planted for crop, and to take them up whenever the *haulm* or stems become of a yellow-green colour. At this period, the cuticle, or outer skin of the tubers, may be easily rubbed off between the finger and thumb.

3. To prevent those plants that are intended to produce seed-stock for the ensuing year, from producing flowers or seeds, by cutting them off in embryo, taking care, however, to take no more off than the extreme tops; as by taking more, the crop may be injured. The best mode of doing this is with a common reaping-hook, or light switching-bill. Two boys or girls may do an English acre in two or three days.

Pulling off the blossoms.—To increase the size of the potatoe, and the amount of its produce, it has been the practice with some to cut away those parts of the potatoe plants which contain the flowers before the blossoms appear. In some trials that have been made, the flowers were carefully picked as soon as they appeared; in others, after they had expanded, or when the fruit had begun to set; and in others, after the fruit or apple was formed and half-grown; and it was found, that the produce from those plants whose blossoms had been plucked off, was nearly double of that in which the apples were allowed to ripen. The crop was also less productive from those plants where the flowers were suffered to waste themselves only; and when the apples had acquired some size, it was still smaller; but, in both cases, it was more abundant than those parts of the drills which remained untouched. The growth of the stems of those plants where the blossoms were plucked off was also observed to be more vigorous than on those where they were allowed to remain. In some other experiments which were conducted to ascertain the same point, it is said that no perceptible difference could be observed in the produce. The following account of experiments on this method of managing the potatoe crop, is extracted from Mr Wilson's General View of the Agriculture of Renfrewshire—a county in which the culture of potatoes is extensively and successfully conducted. "There have been," he says, "many trials of the effect of pulling the flowers or blossoms from the potatoe, to prevent the seed from forming, and the result has been an increase of produce. One gentleman, (Mr.

Arable land.

Wilson at Deanside, near Renfrew,) prosecuted this experiment with great care and attention during the years 1803 and 1804, in fields of two acres, each year, cultivated according to the usual mode, in drills, and planted in manure. By taking alternate portions of equal area in the same field, pulling the blossoms from some of these divisions, and leaving others to ripen the seed, attending in the autumn when the potatoes were taken up, and measuring the produce with great care, he uniformly found, both years, the quantity increased 10 or 15 per cent. where the blossoms were taken off, there being very few small potatoes in these portions of the field. He also found the quality much improved, in consequence of the crop *ripening sooner than usual* where the blossoms had been pulled, and therefore not affected by the frosts, which often set in so early that the growth of the potatoe is completely checked before it arrive at maturity. Having thus ascertained that the quantity and quality of the potatoe crop are much improved by pulling the flowers, he has continued the same practice for the last five or six years, on fields of from four to nine acres; and he considers this experiment well worth prosecuting to any extent. The blossoms are pulled by children from ten to twelve years of age, their wages 6d. per day, and the expence is about 3s. per acre. About four acres of potatoes, from which he took the blossoms in 1808, produced nearly 400 bushels each acre." It is stated by the same author, that experiments made in a different part of the same county serve to confirm the observation, that potatoes ripen sooner when the flowers are taken off.

In a letter published by Mr Young, recommending the extended cultivation of potatoes, it is observed, that this "plant possesses two modes of securing its reproduction, the one by producing tuberous roots, and the other by the general mode of flowers and seed-vessels. It has been ascertained by the ingenious president of the Horticultural Society, Mr Knight, that the plant employs the same fluid in both these operations; and by preventing the consumption of it in either of them, it is made to act more strongly in the other. Upon this principle, if a potatoe plant is carefully deprived of its tubers as soon as they are formed, it will be made infinitely more productive of blossoms and seeds. On the other hand, if its blossoms are picked off, and it is prevented from forming any seed at all, the fluid which would have been employed in that operation, will be expended in forming an increased crop of tubers. It is true, that men who have to attend to the management of hundreds of acres will hardly condescend to think of potatoe blossoms; but there are thousands of cottagers whose scanty pittance may be increased by the simple expedient of employing their children in preventing their potatoe crop from ever forming a seed vessel.

"As it is more than probable that poor people may be led, by the pressure of the times, to have recourse to the new crop of potatoes in their little gardens before they are ripe, and thus occasion a distressing waste in this valuable article of subsistence, the following directions for raising them, may serve, in a considerable degree, to diminish the evil. Instead of taking the shaws entirely out of the ground, as is the common practice, we advise them to apply the spade to the right side of one of the furrows, from which they must carefully remove the earth, until they reach the largest of the potatoes, which they may take up, without materially disturbing the stem. They must then, without loss of time, restore the soil to its former place. After going over the whole of their early crop in this manner, confining themselves always to the right side of each furrow, they may return on their steps, and withdraw the large potatoes in the same way from the left side. By this means the shaws are preserved entire, and the smaller potatoes rather assisted than stopt in their growth, by loosening the earth during the proposed operation."

Digging up and preserving potatoes.—The leaves wither and fall off, and the stems decay, when the potatoe crop is ripe; and no time should be lost in digging it up after these appearances, that it may be secured from the frosts, which are not unfrequent about the period when the later planted potatoes reach maturity. Potatoes are dug up with three pronged forks, or, when the field is large, by means of the plough, which goes twice along each ridgelet, and the potatoes are collected by women and children. When the soil is adhesive, the harrow is sometimes employed to break down the furrow-slice, that the potatoes may be separated from the mould. A light plough, without any coulter, is considered the most convenient implement for this purpose, as the potatoes are less in danger of being injured. Harrowing the land once or twice afterwards is recommended, to bring such potatoes to the surface as may remain buried in the soil. It is scarcely necessary to add, that a dry season should always be preferred for digging up the potatoe crop; and when the whole is raised from the ground, it is a useful practice to spread it thinly upon a dry floor, for the purpose of allowing it to become perfectly dry, before it is stored up for preservation through the winter. It is also useful to separate the small and bruised potatoes from those of a middling and larger size.

The great object to be kept in view in the preservation of potatoes, during the winter and spring, is to secure them from the effects of frost, moisture, and such a degree of heat as causes germination. This is accomplished in various ways; either by burying them in pits under the surface of the ground, or by covering them up with earth and straw, on a dry part of the field, by depositing them in vaults and cellars, or by placing them in houses appropriated to that use. When the situation is perfectly dry, the temperature most suitable for the preservation of potatoes is between the extremes of 48° and 32° of Fahrenheit's thermometer; as, on the one hand, they are not injured by frost, and on the other they are not liable to germination. But as such situations are not every where at command, the progress of germination in the spring and beginning of summer may be retarded, by carefully picking off the shoots, and exposing the potatoes to the sun, or by slight kiln drying, to exhale the moisture; and thus they may be kept much longer in a sound state.

Produce.—The nature of the season, the fertility of the soil, and the more or less perfect culture which is employed, must no doubt occasion great diversity in the amount of the potatoe crop. The produce has been stated to vary from five to eight or ten tons, and the average over the whole kingdom is estimated at six tons from the acre. In Yorkshire, from 300 to 400 bushels of the variety of the potatoe which is used at table, and from 400 to 500 bushels of the kind which is destined for feeding live stock, are considered a good crop. In some extraordinary cases, more than 600 bushels have been raised from an acre in Kent, and in others, the enormous produce of from 700 to 1000 bushels, have been obtained from a rich soil in a favourable season.

9. *Turnips.*

The turnip husbandry, on such soils as are adapted to the culture of that root, has contributed greatly to the present improved state of agriculture in Britain. The cultivation of turnips is an excellent substitute for a naked fallow; for in this way the entire loss of a crop is obviated, and the produce affords a valuable food for the support and fattening of live stock, in a season of the year when other kinds of food are usually expended. The nature of this plant, and the culture which it requires, retain the land on which it is raised in a clean condition, and afford an excellent preparation for such crops as require a fine friable soil.

Soil and preparation.—Turnips may be cultivated on soils of a thin, gravelly, or chalky nature, and even on loamy clays, if they are not loaded with moisture; but they succeed best on those of a light loamy description, or on deep sandy loams. But although turnips may be raised on soil of very different qualities, the success of the crop depends not less on its proper management, than on its fertility; for when the ground is reduced to a friable state, a fine bed is prepared for the seed, by which vegetation is quicker and more vigorous, by the equal diffusion of moisture, and the growth of small seed-weeds is promoted, which admits of their being easily eradicated.

When turnips succeed a fallow, four or five ploughings, with the intermediate operation of the harrow and roller, are necessary. The first ploughing is given about the close of autumn; and the remaining operations, as the cross-ploughing and harrowing, commence about the month of March. When the land is foul with weeds, it should be harrowed at the end of a fortnight; but when it is clean, it is left in its rough state till about the middle of May, when it is ploughed to the full depth, and immediately harrowed, if the season be dry, and the soil tenacious. The practice recommended by some is, to give the first ploughing to the full depth, and the after ploughings and harrowings are continued to the middle of June; but in all these the nature of the soil, the season, and the state of other field operations, are to be consulted. After grain crops, less preparation is required. In some cases, after paring and burning the surface of coarse pastures, good crops of turnips have been raised, by spreading the ashes equally, and by a single shallow ploughing, that the manure from the ashes might not be buried too deep.

Application of manure.—Every kind of manure is employed in the cultivation of turnips; and in general it is recommended to be deposited in the soil as nearly as possible to the period of inserting the seed. In the broad-cast method of sowing, the manure is spread equally, and either turned in with the seed-furrow, or by the preceding ploughing. The state of the soil, and the richness of the manure, must regulate the quantity which is employed. When the crop is drilled, a smaller quantity is sufficient; but as its success greatly depends on the vigorous vegetation of the young plants, the allowance should always be liberal; but lands in a fertile condition, which have been well manured for a preceding crop, may be prepared for the turnip crop without any new application of manure.

Kinds of turnips.—The varieties of the turnip, *brassica rapa* of Linnæus, which are chiefly cultivated in the field, are those of the round and long-rooted kinds. The root of the first kind is round and flattish; and as it varies in colour, has received the different names of *round, red,* or *purple topped, green topped, white topped, yellow, black,* or *red rooted, stone,* and *Dutch* turnip. The second kind is of a longish form, and distinguished by the names of *tankard, tap-rooted,* and *pudding* turnip. These varieties of the turnip are preferred in different districts, according to their different characters of resisting the effects of frost, the size to which they grow, and their qualities as the food of live-stock.

Sowing, &c.—The quantity of seed employed varies from one to two lbs. to the English acre. In the broadcast method in Norfolk, $1\frac{1}{2}$ lib. is sown; but on the sandy soils of Suffolk, and the lighter lands of Yorkshire, one pound is thought sufficient. Chalky soils require a larger proportion; but in general it is recommended as a good practice not to be too sparing of turnip seed, for the redundant plants can be easily thinned out by the first hoeing. The quick and vigorous vegetation of the turnip seed contributes greatly to the success of the crop. For this purpose, steeping the seed in water, or some other liquid, for a few hours, is recommended, before it be sown, and particularly in a dry season.

The time of sowing turnips is chiefly regulated by the mode in which the produce is to be disposed of. For early consumption, the seed may be sown about the beginning of June; but towards the end of the month, or about the beginning of July, is considered the proper time for sowing, when the crop is to be consumed in the early spring months. Mr Dickson of Bangholm sows turnips after hay, from the end of June to the 20th of July, and has been very successful in this practice of double cropping, which he thinks may be advantageously pursued on any turnip land which has not a greater elevation than 200 feet above the level of the sea. The turnips sown at this late period, by continuing their growth through the winter, are better enabled to resist the effects of frost.

Turnips are either sown broad-cast or drilled. The first method is more general in the southern districts, but in the northern parts of the kingdom drilling is more commonly practised. To admit of horse-hoeing, the distance between the drills is from 27 to 30 inches; and for the purpose of inserting the turnip seed with more regularity, the drill-barrow and other machines are employed, by which one or more rows are sown at the same time. The depth recommended, is from one to two or three inches, according to the moisture of the ground.

After-management.—Weeding and loosening the soil are peculiarly requisite in the culture of turnips. In the broad-cast method, hand-hoeing only can be practised. This operation commences about four or five weeks from the period of sowing, or when the plants have acquired four or five leaves. In the first hoeing, when the season is dry, the plants should not be thinned at a greater distance than six or eight inches from each other, that too much of the naked surface may not be exposed; and in the second hoeing, at the end of two or three weeks, they are thinned out from ten to twelve inches distance, while the soil in the vacant spaces is well loosened.

In drilled crops, the first operation after sowing, is to remove the soil from the side of the ridgelets on which the turnips are planted, for the purpose of destroying the annual weeds which have appeared. This work is performed by means of a light plough, or by implements peculiarly constructed for the operation. The plants are thinned in the rows by hand-hoeing, a labour which is usually executed by women and children. In ten days or a fortnight afterwards, according to the state of the weather and the progress of the crop, the earth is pared away from the sides of the drills, and turned into the intermediate space. The hand-hoeing is again resumed, and when the weeding operations are completed the intermediate ridgelet is split up, and laid back to the sides of the drills, by means of a small plough, or scraper; the double mould-boarded plough, or some other suitable implement.

Insects injurious to turnips.—The turnip crop is liable to be attacked by different insects. The turnip fly, *chrysomela saltatoria* of Linnæus, besides some other species, is its greatest enemy; for by wounding the seed leaves, or preying upon them, the young plants are soon destroyed. What is called the *canker* of Norfolk, is to be referred to the ravages of another insect, *tenthredo oleracea* of Linnæus, which is wafted over in myriads with the north-east wind from Germany, and in the course of a day or two destroys whole fields. The black caterpillar, which is supposed to belong to a species of *tenthredo*, commences its depredations on the turnip plants after they have made some progress. The ravages of the common gray slug, *limax agrestis*, are also extremely destructive to turnips; and when the growth of the plants is retarded, and they become feeble and diseased, they are preyed upon by the common earth worm.

No effectual remedy has yet been proposed for the destruction of these insects. The speedy germination of the seed, and the rapid growth of the young plants, when these can be promoted by enriching the soil, and seizing a favourable season for sowing, promise to be the most effectual means of resisting their ravages. With the same view, it has been recommended to steep the seed in water, train oil, lintseed oil, or some other oil, for 24 hours, and after draining and mixing it with finely sifted earth or sand, to insert it immediately in the soil. The use of seed of different ages, or steeping one half of the seed, that it may come up at different periods, is another method suggested, for securing the turnip crop; for as the appearance and departure of the turnip fly are extremely sudden, the plants which come up late often escape their ravages. Strewing vegetable ashes, quicklime, soot, or barley chaff, and sprinkling lime water, tobacco water, and some other liquids, have been practised for the destruction of the fly and slug; and rolling in the night, when the slug proceeds from its lurking place, with a heavy implement, or turning a flock of sheep upon the turnip lands, and keeping them constantly in motion by means of a dog and person to attend them, that the slugs may be shaken from the young plants, are also recommended for the destruction of that animal. Sowing radish seed along with that of the turnip, on the supposition that the radish plant is preferred by the insects, has been suggested as the means of preserving the turnip crop from the depredations of the fly; and planting cabbages in the same field with turnips, it is said secures the latter from the attacks of hares; but it is supposed that none of these practices is completely effectual.

Diseases of turnips.—Turnips are liable to a disease in the root, called *anbury*. A large excrescence forms below the bulb, and after a certain period becomes putrid, and emits a very offensive smell. This disease is ascribed to the puncture or wound of some grub or insect in the vessels of the tap-root. It is most frequent in dry seasons. The only remedy that offers itself, when the affection has taken place, is to remove the diseased plants, and to loosen the earth about those that remain; but by complete preparation, and enriching the soil on which turnips are raised, it is supposed the disease may be altogether prevented. The turnip root is subject to another disease, denominated, in some districts, *fingers and toes*, in which the turnip plant, instead of forming bulbs, sends off a number of separate roots. In some cases, the bulb itself is divided into lobes, but frequently the tap-root is the part which is chiefly diseased, when the bulb seems pretty perfect. These appearances are observed at a very early stage of the growth of the plant, and sometimes even before it pushes out the rough leaf. The leaves remain nearly unchanged, except in hot weather, when they become languid, and droop. In the investigations which have been made into the history of this disease, it has not been traced to the seed, the period of sowing, or any peculiarity in the soil; but it is supposed, from the facts which have been observed, that it may be ascribed to some undiscovered insect, which wounds the root in the earlier stages of its growth. It is said that this disease is most prevalent on fresh soil; and the only method which has yet been recommended for its prevention, is the application of marl, or fresh mould, mixed up with lime.

Produce of the turnip crop.—The season, the soil, and the mode of culture pursued, vary the produce of this crop; but 15 tons are considered as an average crop on an English acre of good soil. Sometimes it amounts to 25 or 30 tons; and in one case, in Ayrshire in Scotland, the enormous quantity of 60 tons was obtained from an English acre.

Raising seed.—To have seed of a good kind, it is best to procure it from turnips which are transplanted one year and sown the next; or if they are transplanted once in three years, it is supposed that the stock may be preserved in good condition. The turnips destined for the production of seed, are to be selected of the best kinds, and of the most perfect forms, from the field crops; and the tops being cut off, are to be transplanted in November or December into a well-prepared piece of ground, which is so situated that it may be protected from the depredations of birds. The seed ripens in July or August following. In some districts, it is the practice to cut part of the stems, to tie them up into sheaves, and when they are dry, to build them into a long stack for preservation till April or May, when the seed is thrashed out; but sometimes it is immediately thrashed out on a cloth, near the spot where it is produced, put into bags, and preserved in a dry situation.

Preservation of turnips.—The turnip crop which is destined for the support of live stock in the winter and spring months, is either consumed on the field, carried off, as it is wanted, to the feeding-houses, or removed entirely, in the beginning of winter, to some convenient place for preservation. The great mass of matter in the turnip root, and the large proportion of water which it contains, render it extremely liable to be destroyed by sudden changes of frost and snow. When the soil is of a moist and retentive quality, it is apt to be poached and injured by the treading of cattle in consuming the crop on the field, or by horses and carts in carrying it off; or when a wheat crop is to succeed the turnips, it becomes necessary in both cases to have them removed. Various methods have been proposed for the preservation of turnips. Sometimes they are piled up with dry straw in houses constructed for the purpose; and sometimes they are stacked in a convenient corner of the field where they grow, with intermediate layers of dry straw, which latter method is practised in Hertfordshire, and one load of straw is employed to 30 or 40 tons of turnips. The turnips are drawn by grasping the tops firmly in the hand; and after twisting the roots round, by which the lateral fibres are broken, and the earth loosened and separated, they are easily pulled up. A dry season should be chosen for this operation; the tops and tap-roots are to be removed, taking care to wound the bulb as little as possible; a layer of straw is spread on a dry part of the ground, and a layer of turnips, to the thickness of 18 inches or two feet, is placed upon it, after which layers of straw and turnips are arranged alternately, till the heap or stack be brought to a ridge or point. The edges of the different layers of straw are turned up, and serve to prevent the turnips from falling out, while they afford an external covering to the heap. The whole is then thatched over with long straw. In some cases, the preservation of turnips has been attempted without straw, by forming them into heaps called *pies*, in the way that potatoes are kept, and merely by thatching them over on the outside. It has been suggested also, that turnips might be built in small stacks, near the places where they are intended to be consumed, with the tops outwards, and with a little straw between the different layers. The stack is then covered over with wattles or hurdles, lined with straw. In some districts, after the turnips are drawn, and the tap-roots cut off, they are removed to a piece of pasture-ground near the farm-yard, and set close together upright on their bottoms. In this way the growth of the tops is little interrupted, and it is supposed by some that the quantity of nutritious food is increased. This operation should be performed in dry and windy weather, because the tops are then less brittle, and the roots are cleaner. The practice which has been suggested, of preserving turnips by means of ice or snow, might, no doubt, with proper precautions, be successful; but with a slight inattention, the whole heaps run the risk of being destroyed. The method advised is to cart the roots, in the time of hard frosts, into heaps, place them on bottoms of ice, and mix them with ice and snow, that they may be preserved in the frozen state till they are applied to use. When preserved in this way, the heaps may be constructed in suitable buildings, or they may be covered up with straw, heath, or some loose and dry material, and a covering of earth laid upon the whole. When the turnips which have thus been preserved are to be given to the stock, or when they are removed in the frozen state from the field for the same purpose, the precaution of putting them into cold water for a few hours, that they may be completely thawed, should not be omitted.

Yellow turnip.—This variety of the common turnip possesses many of the valuable properties of the Swedish turnip. It is hardy, resists the winter frosts without storing or artificial protection, is less liable to putrefaction, and even the wounded part is not apt to run into decay. It has a superior flavour, is more succulent and nutritious, and is preferred by cattle to the Swedish turnip. From these properties, it appears fitter for spring use than the common turnip; and the milk of cows fed with this yellow variety, affords butter which has all the richness of flavour and colour of midsummer butter.

The culture of the yellow turnip is the same as for the common turnip. Early sowing, and less space between the plants, as the roots are in general of a smaller size, are recommended by some; but in some cases, when sown at the same time with the common white turnip, it would appear that they equalled, or even exceeded them in size.

Ruta baga, or Swedish turnip.—The advantages of this excellent root, are briefly stated by Mr Young, who says, that " when the farmer has the right stock of seed, the root yellow in flesh and rough in coat, it lasts through all frosts, and may be depended on for sheep quite through the month of April, though drawn two months before, and spread on a grass field—that it is an excellent and nourishing food for sheep, and also for any sort of cattle—that it is equal to potatoes, keeping stock swine, a point of very great consequence—that it is, next to carrots, the very best food that can be given to horses—and that it is sown at a season which leaves ample time, in

Arable land.

case of a failure, to put in common turnips or cabbages."

Swedish turnip may be raised on soils which are too moist and heavy for the common turnip; but the land requires to be well prepared, and enriched with manure for this crop. Great care is necessary in raising the seed; for if the plants from which it is obtained grow in the vicinity of other species, they are liable to produce degenerated varieties; and this is supposed to be the cause of the occasional occurrence of a spurious crop of inferior quality. Swedish turnip should be sown three weeks or a month earlier than the common turnip. The quantity of seed is from two to three pounds for the English acre, in broadcast sowing, and in drilling a smaller proportion. New seed should always be preferred, and in a dry season steeping is found useful in promoting germination. The seed is sometimes sown upon beds of good soil, and when the plants are about the size of cabbage-plants, fit for transplanting, they are set in rows, at the distance of eight or nine inches in the row, with about a foot of interval; but sowing immediately on the field where the crop is to be produced, is recommended as the best practice. The after-management of the Swedish turnip is similar to that of the common turnip.

10. *Cabbages.*

The culture of cabbages is very limited in the northern parts of the kingdom, and is considered by some as forming no part of the profitable practice of husbandry; while others regard this vegetable as a valuable addition to the winter and spring food of live-stock, and warmly recommend it on such stiff and strong soils as are not adapted to the culture of turnips. The certainty of the cabbage crop, and the larger proportion of food obtained from the same space of ground, are also stated as advantages in favour of its cultivation. Different varieties of the cabbage plant have been employed in field culture; and as mixed or new varieties are extremely apt to be produced, when seed is raised from plants of different kinds growing near each other, great attention should be paid to have the plants which are selected for the produce of seed removed to a distance.

Turnip cabbage.—This variety of the cabbage derives its name from producing a bulb of a roundish flat form, which appears chiefly above the surface of the ground, and seems to be an enlargement of the stem of the plant. The leaves which surround it resemble those of brocoli. This plant is said to be more hardy against frosts than the Swedish turnips, is sometimes cultivated under the name of *Cape cabbage*, and seems to be the *Kohlrabi* of the Germans.

Turnip-rooted cabbage.—This variety of the cabbage has been sometimes confounded with the former; but it differs from it in forming the bulb below the surface of the ground; and besides, it is of an oblong shape, and the leaves approach nearly in appearance to those of the common turnip. But for a full account of the culture and application of cabbage crops, as well as that of rape or cole, which is also employed as green food in winter, for sheep and other animals, the reader is referred to Dickson's *Practical Agriculture.*

11. *Carrots.*

A deep soil, of a loamy or sandy quality, is the best adapted for the culture of carrots; but it is supposed that good crops might be obtained from soils of a more tenacious description, as clay loams, when perfectly dry and well prepared.

Deep ploughing is necessary for a crop of carrots; and where the land has been formerly in tillage, three ploughings may be found sufficient; the first to the depth of ten or fourteen inches, about the beginning of October; the second, a cross ploughing, to the same depth, in February; and the third, previous to the insertion of the seed, in March. The liberal application of manure is necessary for this crop, and it is turned into the soil with the last ploughing. The surface is reduced by the operation of the harrow when it is ready for the seed. But in Suffolk, where carrots are extensively raised, the land receives no preparation till the period of sowing.

Sowing, &c.—Of the different varieties of the common carrot, *daucus carota* of Linnæus, the orange carrot, which is of a darker colour, sweeter and more juicy, and grows to double the size of the pale yellow kind, is generally preferred for field culture. It is of great advantage to the agriculturist to raise his own seed from the best shaped roots of the preceding year's growth, by which practice he is certain of fresh seed of a good quality.

For the purpose of distributing carrot seed equally, it is usual to mix it with sawdust, bran, ashes, dry earth, or sand. The quantity of seed employed is from five or six to ten lbs. to the English acre. The time of sowing is about the middle of March, but it should not be delayed beyond the beginning of April. The early sowed crop is generally found to be the most productive. Mr Burrows of Norfolk, who cultivates carrots to a great extent, mixes the seed which he allows to the acre, from eight to ten lbs., with about two bushels of sand, or fine mould, a fortnight or three weeks before the time of sowing. The heaps formed of the mould and seed are daily turned over, and sprinkled with water, that the vegetation may be equally promoted. By this previous preparation the plants soon appear above the ground, and are less liable to be choked with weeds of a quicker growth.

Carrots are very generally sown broadcast, and the seed is covered in by means of a light harrow. Sometimes drilling is adopted, and the rows are from twelve to eighteen inches distant; and as the nature of the seed scarcely admits of the use of the drill machine, small furrows are formed by the hoe or other convenient implement; the seed is cast over the ground by the hand, and covered in by slight harrowing, or hoeing.

After-management.—The first hoeing, which is required in five or six weeks from the time of sowing, is performed with hoes four inches long and $2\frac{1}{4}$ inches wide; the second, with a six-inch hoe, and of the same breadth as the first, commences nearly as soon as the first hoeing is completed. The carrots are thinned out to the proper distance, which is from nine to 18 inches. A third hoeing is given some time in June, and it may be necessary to repeat the operation, if a new growth of weeds require it.

Preservation of carrots.—When the tops of the carrots become of a yellowish colour, and lose their freshness, they are ready for being taken up, which is generally the case towards the end of October; and as the tops, as food for live-stock, are of considerable value, the digging should not be delayed long, otherwise the quantity is greatly diminished. Carrots are either taken up by means of the plough, or by loosening the soil with three-pronged forks, and drawing up the plants by the tops. The latter method is considered the best. The tops are cut off, and laid in separate heaps; the roots are also heaped up, and allowed to remain in the field for two or three days; they are then removed, and packed up in heaps with dry straw, and, to protect them completely from the frost, they are thatched over with the same material. In whatever way carrots are preserved, they should not be put up too closely together, or in large quantities, as they are apt to be injured by heating, especially if they are not perfectly dry when they are laid up.

Some agriculturists dig up in the autumn a sufficient quantity to supply the live-stock during a lengthened period of frost or snow; the remaining part of the crop is left in the ground; and it appears that the carrots are more relished by the animals when drawn fresh from the soil. In March the whole is taken up to clear the land for the succeeding crop; and such part as is intended to be preserved through the months of May and June, should be examined about the end of April; the crowns of the healthiest and most perfect roots should be cut completely off. The carrots are then separated and laid by themselves, and in this way may be preserved through the month of June.

Produce.—The produce of the carrot crop is from 200 to 350 bushels from the acre of land, of a poorer and middling quality; but 800 bushels have been obtained from a rich soil in good condition. The expence is stated by Mr Burrows, who, in a period of four years, had 49 acres under this crop, at ten guineas the acre for the first three years, and about eight guineas the acre the last year. The estimated profit amounted to nearly L.28 the acre for the first three years, and for the last year the crop of 25 acres was valued by arbiters to the succeeding tenant, and the price fixed afforded a profit of nearly twelve guineas from each acre. These statements afford ample evidence of the value of a carrot crop, where the soil and situation admit of its culture.

Consumption of carrots.—The application of carrots in feeding farm-horses, seems, from their nutritious quality, peculiarly beneficial. Mr Burrows supports his horses solely on this root, conjoined with a suitable proportion of hay, through the winter and spring months; and he finds that they are in the same good condition, and equal to the same quantity of labour, as when they were fed on the full allowance of corn. Seventy pounds weight of carrots is allowed to each horse daily on an average; the proportion is smaller in the short days of winter, and larger in the spring months. The carrots are sometimes sliced down and mixed with cut chaff or hay, and at night they are given to the horses whole, with a small quantity of hay in the rack.

Carrots are greatly relished by all kinds of cattle. They are an excellent winter and spring food to cows giving milk; it is found that the quantity of both milk and butter is increased without any diminution of the flavour; and in fattening live-stock they are not less beneficial. In the application of carrots, with the same view, as the food of sheep, the produce of one acre has been estimated to be equal to that of two acres and a half of turnips,—an advantage which must surely afford full compensation for any extraordinary labour and expence in the culture. Hogs also become fat on carrots, when prepared by boiling; and as poultry are extremely fond of this root when it is subjected to the same preparation, it has been suggested that they might be advantageously fattened with it.

Arable land.

Sect. III. *Of the Rotation of Crops.*

It is now well understood in every district of the kingdom which the improvements of modern agriculture have reached, that land from which the same species of crop is taken successively for a number of years, is sooner and much more exhausted, with the same management, than if an equal, or even a greater number of crops of different species were raised from it, provided no two crops of the same kind shall immediately follow each other in the succession. To render this intelligible to the reader who is unacquainted with practical agriculture, let it be supposed that a farm, consisting of 100 acres, is divided into four lots, and that each lot is destined to produce the same crop for four successive years; as, lot first to have turnips; lot second, barley; lot third, clover; and lot fourth, oats; the whole of the land would be in a much worse condition with regard to its fertility, and the produce would be far more scanty at the end of four years, than when a single crop only of each species is taken from each lot during the same period. The lots which are limited to the production of four successive corn crops would approach to a degree of sterility, from which it would require a long period of the best after-management to recover them. Hence it is obvious, that the selection of the proper kinds of crops, and the order of their succession, form a very essential part of every judicious and profitable sytem of husbandry.

The learned Professor of Agriculture in the University of Edinburgh observes, that it is an important inquiry, how the kinds of produce best adapted for different situations, soils, and purposes, should be selected and assorted, so as to obtain, at the cheapest rate, and with the most certain success, those which are the most advantageous, and best correspond with the nature of the land and the husbandman's means of raising them, keeping in view general economy and profit, and the full supply of manure requisite to support the fertility of the soil. In every system of management, a remark made by the same author should never be forgotten, namely, "that it is always more easy to augment the fertility of any soil in proportion as it is already fertile; or, in other words, it is more difficult to raise the fertility of land from the pitch of bearing five bolls to that of seven, than from seven to nine, or even ten."

Arable land.

"The circumstance of any situation alone can determine," it is farther observed by Dr Coventry, "what are the most proper species of crops for culture; the best proportion in which the different species should be cultivated; and the best order or succession, with respect to one another, in which they should be raised. Certain particulars, in different cases, require the attentive consideration of husbandmen, when about to settle the mode of culture for their arable fields; some of them are of general import, and others more connected with particular or separate possessions.

"1. The general circumstances which require attention in fixing a rotation or course, are, the character of the climate;—the general nature of the soil;—the acquisition of manure, and particularly whether any extraneous supply of putrescent manure can be obtained;—the markets as more or less distant, or as adapted for the disposal of some articles of produce more than others;—and the kind of husbandry followed in other parts of the cultivator's own land, or the general husbandry pursued by him and that pursued in the district at large, so far at least as it may concern his interest, or affect his own scheme; in order that the whole might form one rational, consistent, and united system of husbandry.

"2. Those particulars which are more connected with the management of separate possessions and fields, are,—the advantages of having at suitable times, and of managing in a proper manner, a herbage crop, such as grass, clover, &c.;—the expediency and advantages of cleansing the land of weeds, either by a fallow, with the loss or with the delay of a crop, or with the substitution of one crop for another, or by a hoed crop, otherwise called a fallow crop;—the benefits which attend the raising of crops best adapted to the nature and state of the land;—the propriety of raising the crops most suitable to the condition of the manure;—the benefits that arise from causing the manurings and the cleansing process to correspond in the times when they are performed, and of making the endurance of the herbage crops, and the length of the whole course, such as will suit with these operations, and accomplish this purpose;—the advantages of raising different species of corn and other crops, to divide his labour, and insure more success otherwise;—and the advantage of regularity in cropping, and in the general arrangement of the labour." *Introductory Discourses*, p. 94.

Keeping these particulars in view, the next object of the husbandman is to institute a comparison of the different schemes of culture and cropping, that he may discover how far the latter correspond with the rules which may be deduced from a consideration of the former; for it is only by understanding fully the peculiar advantages of such courses, as well as the disadvantages which are attached to them in certain cases, that he is able to determine what are the most beneficial rotations in increasing his profit, and in improving the soil. Every scheme, then, for the cultivation and cropping of arable land, ought to be formed after fully considering the labour of cultivating the different species,—the manure required for the species of which the course is composed, as well as the quantity which each species is capable of returning,—and the price which the different kinds of produce bring in the market. Such are the rational principles which ought to be adopted in regulating the succession or rotation of crops, and which undoubtedly deserve the most attentive consideration of every judicious agriculturist.

Arable land.

General rules.—In arranging any system of rotation, it has been properly remarked, that no invariable rules can be given which are adapted to all cases, because a great deal depends on the soil, situation, climate, and other circumstances. The material points to be regarded appear to be those of properly suiting the crops to the nature and state of the lands, but especially that of interposing green or root crops between white or corn crops, or the strict observance of what is called the *alternate* husbandry; from which management, ample experience has shewn that while the land continues the shortest time possible unproductive, its fertility is least exhausted. In this way the culture of the field approaches to that of the garden, and the impoverishing effects of an uninterrupted succession of grain crops are avoided, while the amount of produce is greatly increased. But it ought to be observed, that the fertility, even of the richest lands, cannot be retained by a constant course of alternate cropping; and such management on sandy soils, and those of a lighter description, is altogether inadmissible. For the purpose of keeping up the requisite degree of fertility of such lands, that portion which has produced a herbage crop, is allowed to remain in the state of pasture for one or more years. According to this system, which is denominated *convertible* husbandry, the same land is, during one period, under arable management, and during another in the state of pasture. It may be adopted as another general rule, that the same kind of crop should not be repeated at too short intervals. If, for example, the same grain crop, as wheat, were taken from the same land every second year for any considerable period, the quality and produce would be greatly diminished. The recurrence of green crops on the same land, and in the same rapid succession, subjects them to a similar diminution in the quality and produce.

Proportion of green and corn crops.—It has been recommended by the author of the Survey of Middlesex, that where the land is of the best quality, an alternation of green and white, or corn crops, may be pursued; where the land is of a full medium quality, three green crops, and two corn crops, should be taken; but for ordinary land, the proportion should not exceed one corn crop for two green crops; and for poor exhausted land, as that of the Down and Sheep-walk description, one grain crop is sufficient for three green crops. By cropping in this manner, and in the proportions now stated, it is supposed that lands may be preserved in a clean state, and in a proper degree of fertility; and it is added by the author, that "under such management, they might be continued in perpetual aration, with a constant succession of large products." According to the proportions now stated, the four following rotations are suggested: I.—1. corn; 2. clover; 3. pease; or, 1. pease; 2. beans; 3. corn. Here there are two green crops for one of corn. II.—1. corn; 2. clover; 3. tares; 4. turnips; or, corn, clover, peas, and beans; which makes four crops in three years, and three green crops to one of corn. III.—1. tares; 2. potatoes, or cole, for sheep-feed; 3. turnips; 4. corn; 5. clover; which makes five crops in four years, and four green crops to one of corn. IV.—1. pease; 2. beans; 3. corn; 4. clover; 5. tares; 6. turnips; which makes six crops in five years, and five green crops to one of corn.

Rotations on different soils.—In cases where the convertible husbandry is pursued, and horse-hoeing is practised, and the green crops, as turnips, pease, and beans, are sown in double rows on three feet ridges, the following rotations are suggested by Mr Close for different soils. On clay soils, 1. turnips or cabbages; 2. oats; 3. beans and clover; 4. wheat; 5. turnips or cabbages; 6. oats; 7. beans and vetches; 8. wheat. On clayey loams, 1. turnips or cabbages; 2. oats; 3. clover; 4. wheat; 5. turnips or cabbages; 6. barley; 7. beans; 8. wheat. On rich or sandy loams, 1. turnips and potatoes; 2. barley; 3. clover; 4. wheat; 5. beans; 6. barley; 7. pease; 8. wheat; and, 1. beans or turnips; 2. barley; 3. pease or clover; 4. wheat; 5. wheat or potatoes; 6. barley; 7. pease; 8. wheat. On peaty soils, 1. turnips; 2. barley; 3. clover; 4. wheat; 5. potatoes; 6. barley; 7. pease; 8. wheat. On a chalky subsoil, 1. turnips; 2. barley; 3. clover; 4. wheat; 5. potatoes; 6. barley; 7. pease; 8. wheat. On this last rotation it is remarked, that ten acres in each hundred should be laid down with sainfoin for eight or ten years. On gravelly soils, 1. turnips; 2. barley; 3. clover; 4. wheat; 5. potatoes; 6. barley; 7. pease. On light lands, 1. turnips; 2. barley; 3. 4. and 5. clover and ray-grass; 6. pease; 7. wheat or rye; 8. wheat. But although we have detailed the above as a systematic view of rotations recommended for different descriptions of soil, it can scarcely be doubted that some of them are faulty when compared with the rules of good husbandry, and particularly in the frequent repetition of corn crops, sometimes in immediate succession, and in the entire exclusion of fallows, which, it may be justly apprehended, cannot be altogether dispensed with in every kind of soil and situation. In many cases, indeed, the fallow, or horse-hoed crop, may be a sufficient substitute.

In East-Lothian.—The following rotations are pursued in East-Lothian, a district of Scotland where agriculture has reached a high degree of perfection. On lands near the coast, where the soil is a dry gravelly loam, a four-course shift is adopted: 1. turnips, with or without manure; 2. barley, or spring wheat, with grass-seeds; 3. clover, used green for live-stock, or cut for hay; 4. wheat, or oats, if wheat was taken before, manured on the clover ley. On this description of land the turnips are consumed on the ground by sheep; or, what is considered an improvement, a proportion of the turnips is drawn, and carried home for cattle, or eaten by sheep in a contiguous stubble or grass field. Alternate drills are taken out, which is thought the best mode; and in some cases five or six drills are removed, while an equal number is left. By this management the turnip field is less injured in a wet season, and a greater quantity of land is manured. In deeper loams, with a dry bottom, the rotation practised is, 1. turnips; 2. barley, or spring wheat; 3. grass; 4. oats; 5. beans, drilled and horse-hoed; 6. wheat. The manure is only once applied, and is given to the turnips in this rotation, so that it requires the land to be of the best quality. On heavy loams, with a retentive subsoil, 1. fallow, with manure; 2. wheat; 3. beans drilled and horse-hoed; 4. barley; 5. clover, which is manured on the stubble; 6. oats; 7. beans, drilled; 8. wheat. The application of manure twice in the course of this rotation is found very beneficial. On the same kind of soil, the following rotation is also followed: 1. fallow, with manure; 2. wheat, with grass seeds; 3. pasture, eaten by sheep; 4. oats; 5. beans, sometimes mixed with pease, drilled; 6. wheat or oats. In this six-course shift manure is once applied, but the quantity is more liberal; and the pasture succeeding the second year after the fallow, and eaten off by sheep, is a compensation for the second application; and if the wheat be drilled, the rotation may be repeated without a fallow. On thin clays, 1. fallow, without manure; 2. oats, with grass seeds, or, if the fallow was manured, wheat; 3. pasture; 4. oats; 5. beans, manured; 6. wheat. On the poorest clays, 1. fallow, manured; 2. barley or oats, with grass seeds; 3. clover; 4. oats.

The rotation practised on land which is partly a black sandy loam on retentive subsoil, and partly sandy loam on dry sandy undersoil, and in the vicinity of Edinburgh, which affords the double advantage of a ready market for the whole of the produce, and an abundant supply of extraneous manure, is the following, 1. potatoes; 2. wheat; 3. clover, cut green: or, 1. turnips; 2. wheat or barley; 3. clover, cut green.

Distribution of crops.—No precise rules can be laid down for fixing the proportion of any possession which should be occupied by the different crops. The quantity of land destined to each species of crop must be varied according to the soil and situation. But as the great object, in every well regulated system of husbandry, is to preserve the soil in good condition, and at the same time to derive from it the greatest quantity of produce which it is capable of yielding, a certain proportion must always be established between the extent of land allotted to corn and green crops; for if the former greatly exceed the latter, the quantity of manure obtained is deficient, and the fertility of the soil is soon diminished. According to Dr Coventry's statement, the return of manure from a corn crop little exceeds four tons; but the amount from herbage, or green crops, is rather more than six tons from the acre. To preserve land in a suitable degree of fertility, five tons of manure are requisite for each acre annually; and hence it is obvious, that an average proportion between the two kinds of crops must be maintained. The deviations from this average may be more or less extended according to local circumstances.

Chap. VII. Of Grass Lands.

Some kinds of land, from peculiarities of soil and situation, are better calculated for grain crops than

Grass lands. those of grass; others are more suitable for raising grass than corn crops; and others still are better adapted to the convertible husbandry, or the alternate system of corn and grass crops. Lands which are sufficiently dry, and which in their natural state produce only coarse plants, belong to those of the first description, and are found to be more productive in the state of tillage, than in that of pasture. But without specifying particularly those lands which are best adapted for grass crops, it may be observed, that loamy soils which are not too strong for the growth of turnips, are most suitable for the practice of convertible husbandry. They are capable of being changed from the state of tillage to that of grass, and the contrary, not only without injury, but with the most beneficial effects.

In this chapter we shall treat of Artificial Grasses, of Natural Grasses, of Laying down to Grass, of Meadows, of Haymaking, and of Pasture lands.

Sect. I. *Of Artificial Grasses.*

The introduction and culture of different plants, which have been distinguished by the name of Artificial Grasses, constitute one of the most important improvements in modern husbandry. Some of these plants form an essential part in every judicious rotation of crops, and contribute largely, by the abundance of green or dried food which they afford, to the support of live-stock. The plants of this description are, trefoil or clover, sainfoin, lucern, &c.

Red clover.—Red or broad clover, *trifolium pratense*, is a well-known plant, which is successfully cultivated on all the better descriptions of dry land, which are in a tolerable state of fertility. It is sown with any clean grain crop; but when the nature of the soil admits, it succeeds best with barley after turnips.

Seed and sowing.—Fresh and well ripened seed, which smells sweet, has a bright appearance, and is of a purplish colour, should always be selected. On rich clean soils, 10 or 12 pounds are sufficient for the acre; but on less fertile soils of a stiff quality, 16 or 18 pounds are required; and a larger proportion must be allowed when the land is to be under pasturage for two or more years. When it is to be cut for hay, thin sowing is recommended. Clover seed is sown in any of the early spring months, with crops of spring corn, or over the young wheat crop. In the later districts, where it might be injured by frost, it is a better time to sow it with the barley crop in April; and it has been recommended not to insert it till the barley is two or three inches high, which then derives some benefit from the soil being stirred by a slight harrowing. When it is cultivated with a drill crop, it is sown broadcast, when the grain is drilled, and covered in by slight harrowing. It is sometimes also sown before the roller, when the barley is a few inches high; sometimes it is inserted during the hand or horse-hoeing operations. By the use of the roller after the harrow, the particles of the soil are closed upon the seeds, and the surface is levelled, which renders it less affected by drought; and no greater quantity of land should be sown than can be immediately covered in.

When the land is intended for early pasturage, or where the object is hay, it is usual with some to sow ray, rib, and other similar grasses, with the clover; and in this way a more luxuriant herbage is produced, especially on the later kinds of soil; but when the clover is to be cut green, for the purpose of soiling animals, it is the best method to sow it alone. Grass lands.

After-management.—The clover crop, on a good and well prepared soil, requires little future attention. The young plants, while in the seed leaf, are sometimes injured by slugs and other insects. Early sowing, by which the plants become vigorous before the dry weather approaches, is the best method of avoiding this injury. When the grain is removed from the land, it is the practice with some to apply manure over the clover crop; but this application is only necessary when the soil is not in a fertile condition. When the clover is continued for two or more years, a thin covering of manure, in the spring or autumn season, is found beneficial. On dry soils, the manure is most advantageously applied about the end of February; but where the lands are soft and retentive of moisture, the early part of autumn is the most suitable. At whatever season the manure is applied, it should be in a state of minute division, and spread evenly over the surface. When the clover crop is to be mown in the following summer, 30 bushels of coal ashes distributed on an acre, about the end of January, renders it more luxuriant and abundant.

Application of clover.—Clover is either cut for hay, employed as green food for different kinds of live-stock, or fed down with cattle, sheep, or other animals. When the crop is intended for hay, it should be mown as soon as the heads are in full blow, and before they appear of a brown colour, and die away. The proper time is known by observing when the leaves at the bottom of the stems decay and drop off. Early cutting is recommended after these indications of ripeness appear; for when the crop stands long, the plants are greatly exhausted, and a considerable time elapses before they send up new shoots. The clover should remain as it is left by the scythe, or until the swaths are dried about two-thirds through, which, in a favourable season, requires about three days; and if the weather appear promising, they may be turned with rakes immediately after the dew is dissipated. If no rain fall, the clover is ready for cocking up the next morning, or on the fourth day after the dew is off, and it may be carried in as soon afterwards as may be convenient. If this operation be conducted immediately after the dew is exhaled, the leaves are sufficiently tough to resist the effects of handling; but when it is deferred to the hot time of the day, they become too dry, and are liable to be reduced to powder. Some expert haymakers obviate this inconvenience, by putting the rows into heaps, which is performed by gently rolling the swaths over with large forks, and laying them lightly into the cock. By this management the clover is preserved with less loss, and the hay acquires a better colour and finer flavour.

When a second crop is intended for hay, no cattle should be admitted into the field, that the clover may be in full blossom, and fit for the scythe about the end of August. The process of haymaking is conducted in the same way, and it should not be de-

Grass lands. layed later, to avoid loss of weight, and the risk of injury from heavy dews and the rainy season, before it be secured in the stack. The second crop is usually inferior to the first, both in quality, and in amount of produce, so that if hay be not greatly wanted, it is considered a better practice to feed it off with sheep or other animals, where the soil is sufficiently dry, than to make it into hay.

The soil and situation, but especially the season, as it is moist or dry, produces great variations in the amount of the clover crop. Two tons are supposed to be a medium crop for the first cutting; and for a period of 15 or 20 years, the average produce of an acre under this crop, in Middlesex, is estimated at 12 guineas. Clover hay is chiefly employed in feeding draught horses, and is supposed to afford a more nutritious food than any other hay, excepting that of sainfoin. This species of hay is not less useful in feeding milk cows, and in fattening oxen.

Production of seed.—When the clover crop is intended to produce seed, it is sometimes cut for a first crop of hay, and the seed is obtained from the second crop; but it is a better practice to eat it well down in the early part of spring, and till the end of May, by ewes and lambs, or other stock, for in this way the land is less exhausted, and in better condition for the succeeding crop, besides the peculiar advantage of early green food for the live-stock. The crop remains till the husks or blossoms become quite brown, and the seeds have acquired firmness. After being cut down, it is left on the field till it is dry and crisp, that the seeds may be fully hardened. It is then put up as before directed, and the seed is thrashed out in course of the winter. The operation of thrashing out the seed, as it is difficult to separate it from the capsule, is always expensive. Some kind of mills or machinery, it has been suggested, might be usefully employed in diminishing this labour.

Cutting green.—The greatest advantage is derived from the clover crop by cutting it in the green state, and conveying it to the stable and fold-yard, for the purpose of feeding horses and cattle. Applied in this way, it is asserted that the clover crop supports more than twice the quantity of stock than by pasturing or feeding off in the field, and the additional quantity of manure obtained is a full compensation for the expence of cutting and carriage. The remarkable difference between feeding clovers off on the land, and the practice of soiling this kind of crop, is very distinctly stated by Mr Kent: "The quick growth of this grass," he observes, "after mowing, shades the ground, and prevents the sun from exhaling the moisture of the land so much as it would if fed bare; consequently it continues to spring with more vigour, and the moment one crop is off, another begins to shoot up. Whereas, when cattle feed it, they frequently destroy almost as much as they eat; and, besides, bruise the necks of the roots with their feet, which prevents the clover from springing so freely as after a clean cut by the scythe. In hot weather, which is the common season for feeding clover, the flies too are generally so troublesome to the cattle, that they are continually running from hedge to hedge, to brush them off; by which it is inconceivable what injury they do to the crop. But when they are fed in stables and yards, they are more in the shade, they thrive better, and at the same time consume the whole of what is given them, without waste." Grass lands.

Pasturing.—The practice of feeding down, or pasturing clover crops, is, no doubt, in some cases, advantageous, especially where sheep husbandry is pursued; but it should be conducted with no small degree of attention, both to the crop and the animals themselves. Sheep are the best stock for feeding on clover; but on dry soils, calves, foals, and other light kinds of stock, may be occasionally admitted. Pigs thrive well upon clover; and ewes fed upon it afford a greater flow of milk, which renders it a valuable application in the practice of lamb-suckling. The fattening of sheep in April and May, may be profitably conducted by feeding them on clover; and the same practice may be continued in the autumn, till the turnip crop afford a full supply of food. But it should always be recollected, that no kind of stock should be admitted to the clover crop when the land is wet and soft, for otherwise it would be greatly injured by poaching.

Hoving of cattle.—Cattle and other animals, by feeding on clover when in a succulent state, and particularly when it is moist with rain or dew, suffer much, and are sometimes destroyed by the distension of the stomach. In this state, the animal is said to be *blown* or *hoven*. To obviate this affection, which seems to depend on the air evolved from a large quantity of succulent food greedily swallowed, it is recommended not to admit the animals into the field before the moisture has been exhaled from the plants. The remedies proposed for this disease are, a strong solution of salt and water; new milk and tar, in the proportion of about half an egg shell full; stabbing the animal with a sharp penknife in the flank, close to the hip-bone, so as to avoid wounding the intestines, and placing a quill in the orifice, to discharge the confined air; but a long flexible tube, introduced into the stomach through the gullet, affords the safest and most effectual relief, although difficult and troublesome in its application. In the early stage of the disease, a strong solution of ammonia or volatile alkali in water, is also a valuable remedy, by producing an immediate discharge of air from the stomach.

Trefoil, or black nonsuch.—This plant, *medicago lupulina* of Linnæus, is not only useful in permanent grass lands, but may be beneficially employed as an artificial grass. The stem is more slender, and the growth less luxuriant than common clover. It is sown with oats, or among the wheat crop in the spring, when it is to be succeeded by grain in the following season, by which means a good feed is obtained in the stubbles for stock in autumn, while they are left free for tillage in the spring. This plant affords good pasturage for cattle, but it is peculiarly calculated for sheep, either alone or mixed with clover, and with its use they are less liable to hoving. It is earlier than clover, and affords a supply of food after the turnip and rye crops are consumed.

Sainfoin.—Sainfoin, *hedysarum onobrychis*, is a useful plant on the lighter and thinner kinds of calcareous soils; affords a valuable green food in hilly situations; is equally beneficial for the purposes of hay and pasturage, and is less dangerous to the animals which feed upon it, by producing distension of the stomach. The lighter kinds of shallow soils are best adapted for the growth of sainfoin. The ground should be clean and fine for the reception of the seed. It succeeds well after turnips.

Seed and time of sowing.—The seed, selected from the best plants, should be sown fresh. The quantity in the broadcast method is from two to four bushels; in drilling, three bushels are considered sufficient. Early sowing is always advantageous; the latter end of February, or the begining of March, is a proper time in most cases. Sainfoin is sown with any of the spring corn crops, but the best method is with barley after turnips; and it is recommended by some, that only half the quantity of barley which is usually sown for a full crop should be employed. When sown over the wheat crop, it should be harrowed in, and afterwards rolled; and in all the lighter kinds of land, the use of the roller should not be omitted.

After-management.—Much of the success of this crop depends on the after-management. While some advise it to be cut for hay instead of being pastured, others think that it should be neither cut nor pastured till the autumn of the first year. The diversity of practice here recommended, may arise from a difference of the soil, and a greater or less degree of luxuriance in the crop. On rich soils, it may be cut without injury the first year; but on poorer soil it seems better to save the crop entirely, to allow the plants to spread and form a closer sward in the following season. But in all cases, in the succeeding summers a crop of hay is taken, and the after grass is fed down, but not too closely, with any kind of stock except sheep, till December. In the following autumn, sheep, as well as other stock, may be admitted upon the pastures, till they are well eaten down; but they ought to be excluded as early as possible in the beginning of the year.

Sainfoin attains its perfect growth about the third year, and it begins to decline towards the eighth or tenth, unless manure be liberally applied. Sainfoin leys are greatly improved by the application of manure in the latter end of the second autumn. Coal-ashes, peat-ashes, soot, in the proportion of 25 bushels to the acre, and malt-dust, are employed for this purpose. When the crop is well established in the soil, top-dressings of this kind, every third or fourth year, retain it in a state of vigorous growth for 10 or 15 years.

This crop is useful in its green state for all kinds of stock, although it is supposed that the flavour of cows milk is injured by it; but its most usual application is in the state of hay, which affords a very nutritious food for working horses, as well as other kinds of cattle. The hay harvest is conducted much in the same way as for clover. When it is full in blossom, no time is lost in cutting it down, and, by the usual management, it is ready for being put into the stack in a few days.

Preservation of seed.—In preserving the seed of sainfoin, the plants should remain on the land till the husks become of a brownish colour, and the seeds are plump and firm. The crop is then cut down, and remains in the swath till the upper surface is quite dry, when it is cautiously turned over, to prevent the seed from shaking out; and when the whole is perfectly dry and crisp, it is either thrashed out upon cloths in the field, or laid up in stacks till a more convenient time.

Lucern.—This plant, *medicago sativa* of Linnæus, may be profitably cultivated on the deeper, richer, and drier kinds of loamy, gravelly, and sandy soils; but the land should be in the best state of preparation for its reception. With this view, it is preceded either by fallow, or a hoed crop of turnips, carrots, or cabbages.

Seed, and time of sowing.—The seed of lucern is of a larger size, and of a paler colour than that of clover. The freshest seed should always be preferred. The quantity required in the broadcast method is from 18 to 20 pounds to the acre; but when drilled in rows of 12 inches distant, 10 or 12 pounds are sufficient; and in 9 inch rows, which are reckoned the most proper, from 12 to 16 pounds are necessary.

Early sowing, as in the end of March for the southern districts, and the beginning of the following month in more northern situations, is recommended. When the plants are to be raised in a seed-bed, the sowing should be as early as the frosts admit, that they may be fit for transplanting in August. Where the labour of weeding and hoeing the crop cannot be perfectly executed, the broadcast method of sowing may be adopted; but where suitable attention to keep the land in a clean condition can be bestowed, drilling at narrow distances should be preferred. The practice of transplanting can only be had recourse to on a limited scale, and where the soil is rich, that the plants may stand thin and regular, and may acquire a rich and vigorous growth.

The seed is sown either alone or with grain crops. In deeper and richer soils, less time is lost in procuring green food, and there is a greater certainty of obtaining a crop when it is sown alone; but sowing with corn, on lighter and more porous soils, affords the young plants some protection in their early growth; and, according to some, the ravages of the fly are in this way more effectually avoided. When lucern is sown with grain, the quantity of seed of the latter should be less than usual. Oats are considered a better crop to accompany lucern than barley, because it is not so apt to lodge, particularly when it is sown thin. After the grain is sown and harrowed in, the lucern seed is regularly distributed over the surface, and covered in with a slight harrowing. The depth should not exceed two inches. When the drill method is followed, the lucern seed is inserted in the same way immediately after the corn has been deposited. The distance of the drills is best regulated by the condition of the soil. On rich soils, equal distances of a foot is considered sufficient, while, on those of inferior fertility, nine inches only are recommended. The seed soon vegetates, appears in the course of a week, and in a short time spreads over the surface of the land. The sooner it acquires the rough leaf, it is less liable to be injured by the fly; but in very dry seasons, when the growth is slow, it is sometimes entirely destroyed; and if it be a single crop, the method recommended as the most proper, is to plough the land, and sow it again with fresh seed.

After-management.—When lucern is sown broadcast, little attention is necessary after the grain crop has been removed, except keeping all kinds of heavy stock from it; but, in a dry season, it may be fed a little by calves and other light stock. If grass appear after the second cutting, in the following year, it may be moderately harrowed in different directions, and the grass being collected, is removed from the land. This operation should be performed early in the spring; and in the succeeding years similar harrowings may be given in spring and in the end of summer. When drilled, the soil is loosened in the intervals, and hand-hoeing is required to extirpate the weeds; and these operations are continued, as often as may be necessary, during the succeeding years of the crop. When the soil is not sufficiently fertile, manure is sometimes necessary, and the best is well rotted dung; for other matters are apt to encourage the unnatural growth of grasses. While some recommend a slight covering of manure annually, in the spring season, others think it a better practice to apply about 20 tons to the acre every five or six years.

The culture of lucern is attended with great expence; but as it is one of the earliest artificial grasses, it is sometimes ready for the scythe about the end of May, or beginning of June, and in favourable soils it may be cut every five or six weeks during the summer. As lucern affords a nutritious green food, it is highly beneficial in soiling horses and cattle, especially in cases where those animals form a large proportion of the stock; and it is not less important in the soiling of cows and other kinds of cattle in the fold-yards, and in the feeding and fattening of oxen; but it ought to be recollected, that animals feeding voraciously on lucern in its green state, especially when it is moist, are subject to be *hoven* or blown, so that care is necessary to supply them with moderate quantities at a time. Lucern is sometimes preserved for hay; but the most profitable application of this crop is in its green state, for the purpose of soiling live-stock.

Some other plants, as the winter and spring tare, and different species of vetches, burnet, and chicory, are also occasionally cultivated for the purpose of green food for live-stock, or of being converted into hay.

Sect. II. *Of Natural Grasses.*

The attention of agriculturists has been less directed to the history and properties of natural grasses, than the importance of the subject demands. In the selection of the different grasses, the soil and situation best adapted for their culture; their character, as they are more or less hardy; their permanency in the soil, on lands which are to be continued in pasture; the amount of produce which they afford, and the quantity of nutritious matter which they contain, require to be taken into consideration. Many useful and curious facts have been established with regard to the natural history and nutritious properties of the grasses; but observations and experiments are still wanting fully to develope and ascertain the character and valuable qualities of that useful tribe of plants, to enable the husbandman to decide with certainty on the preference to be given to each species, in different soils and situations.

The remarks of Curtis, in his Practical Observations on British Grasses, and the experiments of Mr Sinclair on the comparative merits and value of the different species and varieties of Grasses, an account of which is given in an appendix to Sir Humphry Davy's Elements of Agricultural Chemistry, furnish some useful information. In Mr Sinclair's experiments, the different grasses were cultivated on spots of ground containing four square feet. They were planted or sown, and the produce cut, collected, and dried, in summer and autumn. To determine the nutritive qualities of the different species, equal weights of the dry grasses were acted upon by hot water till their soluble parts were dissolved; the solution was evaporated to dryness with a gentle heat, and the matter obtained carefully weighed. From the works now noticed, the following observations on the character and properties of some of the natural grasses are chiefly extracted.

Sweet scented vernal grass, *anthoxanthum odoratum*, is one of the earliest pasture grasses, and grows in almost all situations, but it is not very productive. It is eaten by horses, oxen, and sheep; but when other grasses are found in the same pasture, it is left untouched. The delicate flavour of hay is derived from this fragrant grass. The produce of an acre of a brown sandy loam, with manure, at the time of flowering, amounted to 7827 pounds, 3 oz.; 80 drs. of the grass, when dried, afforded $21\frac{1}{2}$ drs.; and 64 drs. yielded 1 dr. of nutritive matter. When the seed is ripe, the produce of an acre is 6125 lbs. 10 oz.; 80 drams dried give 24 drs.; and 64 drs. afford of nutritive matter $3\frac{1}{4}$ drs. The after math produce of an acre is 6806 lbs. 4 oz.; and 64 drs. afford of nutritive matter $2\frac{1}{4}$ drs.

Rough-stalked meadow grass, *poa trivialis*, is a productive grass, and well calculated for pasturage or hay. It is much relished by all animals. At the time of flowering, the produce from an acre of light brown loam, manured, was 7486 libs. 14 oz.; 80 drs. dried, afforded 24 drs.; and 64 drs. yielded 2 drs. of nutritive matter. The produce of the acre, when the seed was ripe, was 7827 lbs. 3 oz.; and 80 drs. dried yielded 36 drs.; and 64 drs. gave $2\frac{1}{4}$ drs. of nutritive matter. The produce of an acre of the after math amounted to 4764 lbs. 6 oz.; and 64 drs. gave 3 drs. of nutritive matter. In this case, the crop, when the seed is ripe, affords the greatest proportion both of hay and of nutritive matter.

Smooth-stalked meadow grass, *poa pratensis*, is a common grass in meadows, in dry banks, and on walls. It is eaten by oxen and horses, but sheep prefer other grasses which are found in the same pasture. At the time of flowering, the produce of an acre, on a mixture of bog earth and clay, was 10209 lbs. 6 oz.; 80 drs. dried, gave $22\frac{1}{2}$ drs.; and 64 drs. afforded $1\frac{1}{4}$ dr. of nutritive matter. When the seed is ripe, the produce amounted to 8507 lbs. 13 oz.; 80 drs.

Grass lands. dried afforded 32 drs.; and 64 drs. yielded $1\frac{1}{2}$ dr. of nutritive matter. The produce of the after math was 4083 lbs. 12 oz.; and 64 drs. gave $1\frac{3}{4}$ dr. of nutritive matter. From these experiments this grass is of least value when the seed is ripe; and from the superior value of the grass of the after-math, compared with that of the seed crop, it is well adapted for permanent pasture.

Darnel, or rye, or ray grass, *lolium perenne*, is preferred by sheep, in the early period of its growth, to most other grasses, but when the seed approaches to maturity it is rejected. The hay from this grass is said, from its peculiar qualities, to be well adapted to the feeding of race horses and hunters. At the time of flowering, the produce from a rich brown loam amounted to 7827 lbs. 3 oz.; 80 drs. dried afforded 34 drs., and 64 drs. yielded $2\frac{1}{2}$ drs. of nutritive matter. When the seed is ripe, the produce is 14973 lbs. 12 oz.; 80 drs. of the grass dried gave 24 drs., and 64 drs. afforded $2\frac{1}{4}$ drs. of nutritive matter. The produce of the after-math was 3403 lbs. 2 oz.; and 64 drs. afforded 1 dr. of nutritive matter. The greatest quantity of nutritive matter is obtained from this grass when the seed is ripe.

Meadow fescue, *festuca pratensis*, is an early, perennial, and hardy grass; thrives well in almost all soils, especially in rich meadows and pastures; produces a sweet herbage; affords excellent hay, and is highly grateful to most animals. At the time of flowering, the produce from a bog soil, manured with coal ashes, amounted to 13612 lb. 8 oz.; 80 drs. when dried, afforded 38 drs., and 64 drs. gave $4\frac{1}{8}$ drs. of nutritive matter. The produce, when the seed is ripe, was 19057 lbs. 8 oz.; 80 drs. when dried afforded 32 drs., and 64 drs. gave $1\frac{1}{2}$ dr. of nutritive matter. From these statements, it appears that this grass is most valuable when cut and dried at the time of flowering.

Meadow foxtail, *alopecurus pratensis*, is an early and productive grass, vegetates quickly, and grows very luxuriantly. It is more relished by sheep and horses than by oxen. It delights in a soil which is neither too moist nor too dry. At the time of flowering, the produce from a clayey loam is stated at 20,418 lbs. 12 oz.; 80 drs. when dried yielded 24 drs., and 64 drs. gave $1\frac{1}{2}$ dr. of nutritive matter. The produce from a sandy loam amounted to 8507 lbs. 13 oz.; 80 drs. dried gave 24 drs., and 64 drs. yielded 1 dr. of nutritive matter. When the seed is ripe, the produce from the clayey loam was 12,931 lbs. 14 oz.; 80 drs. dried afforded 36 drs.; and 64 drs. gave $2\frac{1}{4}$ drs. of nutritive matter. The after-math produce from the clayey loam was 8167 lbs. 8 oz., and 64 drs. gave 2 drs. of nutritive matter. In this case, the produce from the clayey loam is nearly $\frac{3}{4}$ greater than from a sandy soil, and the crop of the latter is also of less value.

Crested dog's-tail grass, *cynosurus cristatus*, is a useful grass in upland pastures, produces a thick, short turf, and affords a wholesome food for sheep. The South Down sheep, and deer, it is said, are very fond of it, but it is neglected by the Welsh breed of sheep. At the time of flowering, the produce from brown loam, manured, is stated at 6125 lbs. 10 oz.; 80 drs. when dried, afforded 24 drs., and 64 drs. gave $4\frac{1}{4}$ drs. of nutritive matter. When the seed is ripe, the produce amounted to 12,251 lbs. 4 oz.; 80 drs. dried gave 32 drs., and 64 drs. yielded $2\frac{1}{2}$ drs. of nutritive matter. Grass lands.

Meadow soft grass, or Yorkshire white, *holcus lanatus*, is a common grass in almost all soils; but it is little relished by cattle, and the hay made from it is also disliked. The produce of an acre of a strong clayey loam, both at the time of flowering and when the seed is ripe, amounted to 19,057 lbs. 8 oz.; 80 drs. at the time of flowering, gave, when dried, 26 drs., but when the seed was ripe only 16 drs.; and 64 drs. afforded, at the time of flowering, 4 drs. of nutritive matter; but when the seed is ripe $2\frac{1}{4}$ drs. The weight of nutritive matter lost by leaving the crop till the seed be ripe is nearly $\frac{1}{3}$ of its value.

Meadow cat's tail, or Timothy grass, *phleum pratense*, is readily eaten by all animals. It grows most luxuriantly in a rich deep loam. It is extensively cultivated, and in high repute, in the middle and northern states of America; but it is asserted by Mr Curtis, that it possesses no superior excellence to the meadow foxtail. At the time of flowering, the produce from a clayey loam amounted to 40,837 lbs. 8 oz.; 80 drs. dried afforded 34 drs., and 64 drs. gave $2\frac{1}{4}$ drs. of nutritive matter. At the time the seed is ripe, the amount of produce is the same: 80 drs. dried afforded 38 drs. and 64 drs. gave $5\frac{1}{4}$ drs. of nutritive matter. The produce of the after-math is stated at 9528 lbs. 12 oz.; 64 drs. of grass afforded 2 drs. of nutritive matter, and 64 drs. of the straws gave 7 drs. of nutritive matter; so that the nutritive qualities of the straw greatly exceed those of the leaves.

Cock's foot, *dactylis glomerata*, is readily eaten by oxen, horses, and sheep. The oxen continue to eat the straws of the flowers from the time of flowering till the seed is ripe. At the time of flowering, the produce from an acre of rich sandy loam is 27,905 lbs. 10 oz.; 80 drs. dried gave 34 drs., and 64 drs. yielded $2\frac{1}{4}$ drs. of nutritive matter. At the time the seed is ripe the produce is 26,544 lbs. 6 oz.; 80 drs. of grass afforded, when dried, 40 drs., and 64 drs. gave $3\frac{1}{2}$ drs. of nutritive matter; so that the weight of nutritive matter gained by leaving the crop till the seed be ripe is more than $\frac{1}{3}$ of its value. From a comparison of the value of the after-math of this grass, with that at the time of flowering, and when the seed is ripe, it appears that the greatest advantage is derived from it when it is closely cropped, either with the scythe or cattle; and, when managed in this way, it is regarded as a very valuable grass.

Creeping bent grass, or fiorin, *agrostis stolonifera*, is, in many cases, a very valuable grass, and was first brought into notice by Dr Richardson. It succeeds best in a moist climate, or on a wet soil; and on cold clay soils, which are unsuitable for other grasses, it grows luxuriantly; but in dry situations, and on light sands, the produce of this grass is greatly diminished, from which it appears that all soils and situations are by no means fitted for the culture of this grass, as has been loosely and indiscriminately represented. Moist and warm sheltered spots are probably the most appropriate for its vigorous growth. It is readily eaten by horses, sheep, and oxen. Presented in the state of hay to horses, along with common hay, no marked preference appeared; but in a green state it was preferred to hay, both by cows and horses. A very extraordinary produce has been obtained from a crop of this grass. In one case, on a damp stiff clay, four square yards, cut in the end of January, afforded 28 lbs. of fodder; in another case, the same space yielded 27 lbs. of grass. In a trial made of this grass by Lady Hardwicke, 23 milk cows, a young horse, and a number of pigs, were kept a fortnight on the produce of a single acre. A similar abundant produce has been obtained from this grass, in Ireland, where it was first cultivated, and in different places, both in the northern and southern districts of Britain. At the time of flowering, the produce from an acre of bog soil amounted to 17,696 lbs. 4 oz.; 80 drs. when dried yielded 35 drs., and 64 drs. gave $3\frac{1}{2}$ drs. of nutritive matter. When the seed is ripe, the produce is stated at 19,057 lbs. 8 oz.; 80 drs. dried afforded 36 drs., and 64 drs. gave $3\frac{1}{2}$ drs. of nutritive matter; so that the weight of nutritive matter which is lost by taking the crop at the time of flowering is nearly a fourteenth of its value.

Beside the natural grasses now enumerated, several other plants, which are the spontaneous productions of the pastures and meadows of this country, may be added to the list; as, hard fescue, *festuca duriuscula*, which grows luxuriantly in almost all situations; sheep's fescue, *festuca ovina*, a perennial grass, which appears on dry, sandy soils, and is a favourite food with sheep; float fescue, *festuca fluitans*, which grows in moist places, and sometimes even in the water, forms a constituent part of some celebrated meadows in England, and is greedily eaten by horses and cows; red meadow grass, *poa aquatica*, shoots up vigorously on the drained lands of Cambridgeshire and Lincolnshire, and not only affords rich summer pasturage for cattle, but forms the chief part of their winter fodder; water hair grass, *aira aquatica*, to which the fine flavour of Cambridge butter is ascribed, is generally found on the edges of pools and standing waters; hop clover, or hop trefoil, *trefolium procumbens*, grows in dry pastures and meadows, and is strongly recommended for laying down land to grass, for when mixed with red clover, on light soils, it affords excellent fodder; red perennial clover, or cow grass, or marl grass, *trefolium medium*, remains longer on the land than the common clover, and rises spontaneously on calcareous soils; white or Dutch clover, *trefolium repens*, thrives luxuriantly on dry, sandy, or loamy soils, and sown with red clover and ray grass affords excellent hay; rib grass, *plantago lanceolata*, which produces abundance of herbage on rich sands and loams, but doubts are entertained of its utility as a pasture grass, and therefore it seems to have fallen in estimation; and Yarrow, *Achillea millefolium*, grows in almost every kind of soil, is reckoned one of the most valuable pasture grasses, from its remarkable property of resisting drought in dry seasons, and is much relished by all kinds of cattle, especially by sheep.

Sect. III. *Of Laying down to Grass.*

The previous tillage of land which is intended for the reception of grass seeds should be conducted in the most perfect manner. As the seeds are small, the soil should be in the most friable state, either by the frequent repetition of the operations of ploughing, harrowing, and rolling, immediately after the insertion of the grass crop, or by the frequent interposition of green fallow crops. But beside this mechanical preparation of the soil, it is not less requisite that it should be in a high state of fertility, either by the liberal application of manure to some of the preceding crops in the rotation, or what is recommended as the best practice, to that crop which is immediately succeeded by the grass. It is not less useful that lands intended for grass should be perfectly free from all kinds of weeds.

The furrows and ridges of grass lands, where the soil is of a light, porous, and dry nature, may be entirely obliterated, and the surface rendered smooth and even, by which the future operations in the grass management are greatly facilitated; but in soils which have a tendency to moisture, ridges of 6, 8, or 10 yards broad, with slight furrows, may be formed.

The selection of the proper kinds of seed is a matter of great importance in laying down lands to the state of grass. The peculiar habits of the plants, and the soils and situations to which they are best suited, are to be taken into consideration. The requisite proportion of seed also demands some attention. A larger proportion is found necessary for lands which have been long in the state of tillage, which are in cold exposed situations, and which are intended for pasture. No precise rules can be given, with regard either to the kind or quantity of grass-seeds which are best suited to different soils. The following have been suggested by the most approved writers on this subject.

Clayey soils.—For such soils, the following kinds and proportions are recommended. Marl or cow grass 5 lbs.; trefoil 5 lbs.; crested dog's-tail 10 lbs; meadow fescue 1 bushel; meadow fox-tail 1 bushel; or if the three last cannot be got, meadow soft grass, or Yorkshire white 2 bushels; meadow cat's-tail or Timothy grass 4 lbs.; or meadow cat's-tail 4 lbs., and Yorkshire white 1 bushel. On heavy kinds of land, which is to be broken up in a year or two, from 10 to 14 lbs. of red clover may be added; but if they are to remain in permanent grass, marl or cow grass, from 4 to 6 lbs. and white clover 4 lbs.

Loamy soils.—The following proportions are recommended as suitable for such soils: White clover 5 lbs; crested dog's-tail 10 lbs.; ray grass 1 peck; meadow fescue grass 3 pecks; meadow fox-tail 3 pecks; Yarrow 2 pecks. Where the second cannot be had, ray grass 1 peck, rib grass 4 lbs; and as substitutes for the last three, meadow soft grass, or Yorkshire white, half a bushel, meadow cat's-tail or Timothy grass 4 lbs., marl or cow grass 5 lbs. On all dry soils, white clover 4 lbs., marl or cow grass from 4 to 6 lbs. and yellow clover, from 2 to 4 lbs.

Grass lands. For permanent pasture, white clover, marl, or cow-grass, and yellow clover, from 6 to 7 lbs. each, with ray grass one bushel.

Sandy soils.—On this kind of soil some recommend white clover 7 lbs.; trefoil 5 lbs.; Burnet 6 lbs.; ray grass 1 peck; Yarrow 1 bushel; or, instead of the last, rib grass 4 lbs., ray grass 1 peck. But on such soils, others, guided by experience, employ white clover and trefoil in the proportion of 5 lbs. each, with a bushel of ray grass, and the same quantity of collected grass seeds, to the acre.

Chalky soils.—For such soils the following quantities are recommended: Burnet 10 lbs.; trefoil 5 lbs.; white clover 5 lbs.; Yarrow 1 bushel, or in its place ray grass 1 bushel. Others advise, for the same kind of soil, rib grass 8 lbs., white clover and marl or cow grass each 4 lbs., and yellow trefoil 4 lbs.

Peaty soils.—The following proportions succeed well on this kind of soil: White clover 10 lbs.; crested dog's tail 10 lb.; ray grass 1 peck; meadow fox-tail and meadow fescue, 2 pecks each; Timothy grass 1 peck; or, in place of the second, fourth, and fifth, meadow soft grass 6 pecks, rib grass 5 lbs. marl or cow-grass 4 lbs.

Laying down land for the purpose of meadow, the following proportions are recommended for the moister kinds of soil. Meadow fox-tail and meadow fescue, each $2\frac{1}{2}$ pecks; crested dog's-tail and vernal grass, each $\frac{3}{4}$ peck; rough stalked and smooth stalked meadow grass, each $1\frac{1}{2}$ peck; white and red clover, each from 1 to 2 quarts: but for lands of a wetter description, the crested dog's-tail and smooth stalked meadow-grass, may be omitted. The prevailing grasses of the Orcheston meadow, near Salisbury, which has been long celebrated for luxuriant herbage, are chiefly common meadow grass, *poa trivialis;* marsh bent grass, *agrostis palustris;* meadow fox-tail, *alopecurus pratensis;* but in speaking of grasses proper for meadows the fiorin ought not to be omitted, from which, in favourable situations, an abundant produce may be always expected.

Sowing grass seeds.—Grass seeds are sown in the spring, along with the grain crops, or in harvest, after the ground has been well prepared by means of some green or fallow crop. Some diversity of opinion prevails with regard to the preference which ought to be given to these periods of sowing. Each probably has its peculiar advantages, arising from the climate and situation, as the winter is more or less severe, and from the state of the soil, as it is more or less exposed to wetness. As land is always in a fine state of preparation for barley, this crop is peculiarly favourable to accompany grass seeds; and where a selection is permitted, that kind of barley which runs least to straw, and is earliest ripe, should be preferred. The equal distribution of the grass seeds is of great importance, so that the lighter kinds should not be sown in windy weather, except by means of a machine, which not only distributes the seeds uniformly and equally, but being surrounded by a kind of curtain, which protects the seeds from the action of the wind, the sowing process may be perfectly accomplished at all times. The seeds are covered in with a pair of light, short-tined-harrows. Bush-harrowing is improper, because the seeds are collected into thick patches. The use of a light roller, after harrowing the lighter and more porous soils, is beneficial. Grass lands.

After-management.—When the crop is removed, rolling with an implement of moderate weight is recommended, particularly for lighter soils. Some advise manure to be applied at the same time, but if the land be in a proper degree of fertility, this application is unnecessary; and it may be observed, that where top-dressings are at any time required for grass lands, the manure employed should be in such a state of division as to enable it to fall down among the plants, and mix immediately with the soil. When grass lands are intended for permanent pasture, early feeding down with cattle, or some kind of stock, for the purpose of producing a thick sward, is sometimes resorted to; but when this is judged necessary, if there be any risk of breaking the surface, and poaching the land, every kind of stock should be at all times excluded. Spring feeding with ewes and lambs is thought by some the most beneficial practice, and, in some places, feeding entirely with sheep is continued for the first two years. The mowing of such grass lands as are too moist to admit the treading of live stock without injury, greatly promotes the closeness and fineness of the sward; but the precaution should be attended to, of using the scythe, before the grass runs to seed.

Ant-hills, &c.—Ant-hills are injurious to grass lands, not only as occupying part of the soil, but by obstructing the operation of the scythe. The usual method of removing them is, by dividing the covering of sward into four parts from the top, and then digging to such a depth as to separate the whole nest of the insects, so that when the turf is replaced, it may be rather lower than the surface of the land. This renders the spot somewhat moist, and prevents the ants from returning to it. That part of the soil which is removed from the hillock, is either scattered on the field, or carried off to be mixed up with compost manure. Another method of destroying ant-hills is to cut them up in irregular lumps, and turning the grass side downwards till the mould be dry, and then exposing the surface to the air, till the whole be so dry as to burn readily. A fire is kindled with brushwood, and kept smothering, by gradually laying on the sods or lumps, till 10 or 20 loads of ashes are raised in one heap. In this way a nuisance is removed, and a valuable manure is obtained. Mole-hills are also extremely injurious to grass-lands; but this nuisance is generally removed by persons who practise the business as a separate profession, and who are well acquainted with the habits of the animal by which they are occasioned.

Sect. IV. *Of Meadows.*

Grass lands, which come under the denomination of meadows, are in low or moist situations, and are usually reserved for the production of hay. Such lands as may be profitably kept in the state of meadow, are in the vicinity of rivers or brooks, which admit of the essential improvement of irrigation, by which the amount of their produce is greatly augmented. Good meadow land should have a sufficient depth of soil, to prevent the roots of grasses to penetrate beyond the reach of the summer heat, and the soil should be sufficiently retentive to hold water long enough to encourage and promote the growth of the plants, while the under-soil possesses that degree of openness, to allow the water to pass off before the roots are injured.

In the management of meadow lands, the stagnation of water should be prevented, by which the growth of various noxious weeds is promoted, to the great injury of the herbage crop. Manure is applied to such lands at various intervals; in some places it is laid on in October, when the land is sufficiently dry to bear loaded carts; and in others, the application is made after the hay is removed. Rolling meadow land is highly beneficial; this operation is generally performed towards the end of February, or the beginning of the succeeding month, but it should never be had recourse to till the land be sufficiently dry.

Irrigation.—Great benefits are derived to meadow lands from the occasional and judicious application of water. Soils of a sandy or gravelly nature are the most suitable for this operation. Even strong adhesive soils are improved by watering, and lands which throw up coarse plants, as heath or rushes, are rendered more productive of useful herbage.

The verdure, luxuriance, and increased produce, which are the consequence of the occasional covering of grass lands with water, afford the most decided proofs of the beneficial effects of irrigation. Some of the advantages of this operation are to be sought in the enriching materials, whether of a vegetable or mineral nature, which are deposited by the water; but the protection of the roots of the grass and other plants, during the severity of the cold of the winter and spring, is stated as another advantage of floating the land. Sir Humphry Davy examined the temperature in a water meadow in Berkshire, and while the thermometer in the air at seven in the morning stood at 29°, and the water was frozen above the grass, the temperature of the soil among the roots of the grass was 43°.

The time of watering meadows is from November to the beginning of March. In some districts it is the practice to allow the water to flow for several weeks together, with an occasional interval of a day or two, while in others the flooding is performed by alternate weeks. The floating is usually suspended during frost, and as the spring advances the application of the water is diminished. The sandy, gravelly, and drier kinds of land require the flooding to be continued a shorter time than upon stronger soils. The duration for the first watering in November is from three to six weeks; in December and February the water should be allowed to flow off for a few days, and in the latter month it should not be permitted to continue many days together without being removed, that the danger of the scum settling on the surface may be avoided. Exposure to frost, when the ground is wet, is injurious; this inconvenience is obviated by removing the water in the day, and flooding through the night.

In the southern districts, the grass is usually sufficiently luxuriant in March to admit the feeding stock; but a fortnight at least should elapse after the water is turned off, that the ground may acquire a sufficient firmness before they are turned in. The grass may be eaten close in April, but no later, otherwise the hay crop may be diminished. The lands are again flooded in May for a few days after being fed down, by which means the produce of hay is greatly augmented. But for a fuller detail of the advantages of irrigation, and of the method of conducting the operation, the reader may consult Boswell on Watered Meadows; Wright on Floating Meadows; or Johnstone's Treatise on Draining and Irrigation.

Warping.—This is a provincial term for the operation of improving land, by admitting the tide waters of rivers near the sea, or of rivers with a slow current, in flat inland situations, for the purpose of depositing the earthy and organic matters, to which the name of *warp* is given, on the surface of the land. In conducting the operation of warping, the water must be completely at command, that it may be excluded or admitted at pleasure. The land to be warped is embanked against the river; a canal is formed which communicates with it, and has a sluice at the mouth, which is opened or shut as may be necessary. Another opening is made at the lower part of the warped land, to permit the water to flow gently off. This process must be extremely limited for the improvement of grass lands, for the quantity of matter deposited would soon cover and destroy the herbage crop. The object of the operation, it is properly stated, is rather to create a new soil; and this is sometimes effected in a single summer, from six to sixteen inches in thickness, and in all cases of a very fertile quality. The practice of warping usually commences in the month of June, and is carried on throughout the summer; in winter, and during the floods, the operation ceases. It is extensively prosecuted on the banks of the Ouse and Trent, and it may be adopted on all low lands adjoining to rivers, the waters of which are often loaded with mud.

Sect. V. *Of Hay-making.*

In determining the proper time for cutting grass crops intended for hay, attention is necessary to that state of growth and ripeness which affords the largest amount of produce, and at the same time the most nutritious fodder. Early and late cutting are equally to be avoided; as, in the one case, a great loss in drying, from the green condition of the crop, is sustained; and in the other, its nutritious quality is exhausted. The experiments which have been detailed in Section II. from which the quantity of nutritive matter, at the time of flowering and when the seed is ripe, is ascertained, may assist in fixing the most suitable time for cutting down the grass crop, by a reference to the comparative quantities of the whole produce, and of the nutritive matter which it contains at the different periods. Cutting down the grass crop should rarely be delayed beyond the time that it is in full flower; for when it is thick upon the ground, the lower leaves become yellow, induce a tendency to rotting, or communicate a disagreeable flavour; the seed stems become hard and wirey, and the produce of the after-grass is greatly diminished.

In cutting down the grass crop, the scythe should be kept perfectly level, and as close to the ground as possible, while the swaths are well pointed out, and scarcely any ridges are left under them. More attention is requisite in cutting the rowen, or second crop, because it is lighter. When it can be accomplished, crops of this kind should be cut when the dew is upon them, and as soon as there is a tolerable drought; for, by delay, the unfavourable weather retards the progress of hay-making.

Ray-grass and clover.—As the object of hay-making is not to bring the grass to that dry and withered state in which it would break and crumble down with the slightest handling, but to allow the superfluous moisture to be exhaled, which would be injurious to its preservation, when laid up in heaps, it is of importance that the different operations be speedily performed, and with as little exposure of the crop to the air as possible. Various modes of conducting these operations have been pursued. The following is found fully to answer the purpose. When the swath is thoroughly dry above, it is carefully turned over, without breaking or separating; and in favourable weather, the grass, which is turned over in the morning is put into cocks in the afternoon. This work is generally executed by women and children, under the direction of a superintendant. When the crop is heavy, a row of cocks is formed in the middle ridge of three, and if the crop be light, of five ridges. To every such number of ridges, a distinct number of carriers and rakers is appointed. The carriers collect the hay, and carry it to the ridge where the cock is built; a raker follows, raking up and bringing to the cocks the remainder of the swath. Five persons are usually required for each row of cocks, a carrier and raker on each side of the ridge, beside the builder; but when the crop is less weighty, as it is spread over a larger space, a greater number of rakers is necessary.

As the drying process proceeds, two or more cocks are formed into one, and the larger cocks may be speedily drawn together by ropes thrown round the bottom, and dragged along by a horse, for the purpose of being put into tramp-ricks. In some cases, the cocks were put up of such a size that they were carted directly to the stack-yard without being broken, and put up in alternate layers with old hay; but it is not safe to practise this method, where the proportion of clover is considerable. By mixing the new hay with the old, much time and labour are saved, and the old hay is greatly improved.

Another mode.—The method of making hay by what is provincially called *tippling* or *rippling*, first practised in Lancashire, has been introduced into the western districts of Scotland. The operation commences as soon as the crop is cut down. In making a tipple, a person with his right-hand rolls the swath onwards until he has a small bundle. The same is then done with the left till both meet, and form about eight or 12 lbs. weight. The bundle is set up between the feet; a rope is twisted of the grass, and tied round the rop of the bundle, and from the top are drawn a few straggling stems, which are twisted to give the tipple a conical shape. For a strong crop, a row of tipples is requisite to each swath; but when it is light, two swaths are put into one row. After standing a few hours, they become so smooth on the outside, that they are rarely wet through by the heaviest rains; and when they are wet, they are soon dried on the return of good weather. As soon as they are ready, they are put into the summer-rick, or if they are very dry they are carried directly to the winter stack; and as they are never opened out, or *tedded*, not a blade is lost, and the hay retains its green colour and rich fragrance. Hay put up in this manner is perfectly secure, although the duration of wet weather should be considerable.

Meadow-hay.—As the hay crop is of great importance on lands in the vicinity of the metropolis, where the consumption is large, much attention has been paid to the method of curing and preserving it. A very improved and successful system of managing this branch of rural economy has been introduced into Middlesex, and is minutely described by Mr Middleton in his Report of that County.

In the operations of the first day, all the grass cut before nine o'clock in the morning is tedded or spread out evenly over the whole surface of the ground. It is soon afterwards turned, and if the number of hands be sufficient, the whole is turned again before 12 or 1 o'clock. It is then raked into single wind-rows, at the distance of three feet; and the last operation of the day is to collect it into grass-cocks. Next day, all the grass that was cut the preceding day after nine o'clock, and all that is mown this day before that hour, is spread out; the grass-cocks are then shaken out into staddles, or separate plats of five or six yards in breadth. When the crop is thin, and the spaces between the staddles rather large, they are immediately raked clean, and the rakings are mixed with the other hay, that the whole may dry equally, and have a uniform colour. The staddles are next turned, and afterwards the grass which was tedded in the first part of the morning, once or twice, as on the first day. All these operations are executed before 12 or 1 o'clock, that the whole may be allowed to dry while the people are at dinner. The staddles are next raked into double wind-rows, which is done by every two persons raking the hay towards each other, and forming a row between them of double the size of the single wind-rows, which are at six or eight feet distant from each other. The grass is afterwards raked into single wind-rows; the double wind-rows are put into bastard cocks, and the single wind-rows are formed into grass cocks, which concludes the business of the second day. On the third day, the grass cut and not spread the day before, as well as that cut in the early part of this day, is spread out; the grass cocks are thrown out into staddles, and the bastard cocks into staddles of smaller extent. The narrow staddles, though last spread out, are first turned, then those which were in grass cocks, and last of all the grass is turned once or twice before 12 or 1 o'clock. In sunny weather, the hay which was last night in bastard cocks is this afternoon fit to be carried; and, if this be the case, the first operation after dinner is to rake that which was in grass cocks last night into double wind-rows, and afterwards the grass which was this morning spread from the swaths into single wind-rows. The hay which was last night in bastard cocks, is made up into full sized cocks. The hay

Grass lands.

should be raked clean, and the rakings put upon the top of each cock. The double wind-rows are then put up into bastard cocks, and the single ones into grass cocks, as in the preceding days. On the fourth day, the great cocks are mostly carried before dinner, and the other operations are similar to those of the former days; they are conducted in the same order, and continued daily, till the whole be finished.

For the purpose of abridging labour in the operations of hay-making, and of collecting the hay speedily together in bad weather, different implements have been invented. The hay-sweep is so constructed as to be drawn by two or four horses, according to its size, and is managed by two boys, one of whom, mounted on one of the horses, drives each pair. On level ground, nothing more is necessary than to break and turn up the rows of hay in different places, to allow the machine to operate; but when the ridges are high, and the surface unequal, the hay is raised by means of a fork, just before the machine, that it may catch and sweep it along. The hay-sledge employed in Yorkshire, is said to be a preferable machine, because it operates with more facility on uneven surfaces; and where there is a deficiency of hands, the hay-turner, invented by Mr Salmon, and described in the preceding chapter on implements, may be found useful in spreading and turning the hay crop.

Stacking hay.—In stacking hay, it is recommended to have staddles, by which the communication with the ground is cut off, and the access of moisture to the lower parts of the stack prevented. An oblong square is the best form; and about 24 feet by 14 or 15, is a convenient size. The business of stacking hay is best performed while there is a full sun especially in indifferent seasons, for in such circumstances it is greatly improved. To prevent the hay from heating, various contrivances, as holes, pipes, and chimneys, have been resorted to, for the purpose of allowing a circulation of air; but where it can be done, it is better to avoid such openings, as the hay round them is found to be injured by attracting the moisture of the stack.

Improved hay-rick.—Mr Chambers of Stratford Place, in a communication to the Board of Agriculture, has proposed a new method of constructing a hay-rick, by which the danger of hay taking fire, from being put up too green, is avoided, and other benefits are obtained. A channel or gutter, a foot wide, and a foot deep, is cut through the ground which is marked out for the rick, and two channels are cut transversely, dividing the rick lengthwise into three parts. Two chimneys, like the common hay funnels, reach to the points of intersection of the longitudinal and transverse channels. The channels are previously covered, except where the chimneys terminate. The chimneys are drawn up as the rick is built, so that they form a communication from the bottom to the top of the rick, and by means of the channels, from two points on each side, and from one at each end; and hence, from whatever quarter the wind blows, a constant current of air is kept up. The chimneys are thatched over when the heat subsides.

The advantages of this mode of construction are, that the hay may be carried a day earlier, by which it is less exposed to the weather; the expence of a day's labour is saved, the weight of the hay is greater, and the exhalations of moisture not being allowed to accumulate, the risk of the hay taking fire is obviated. Mr Chambers formed a rick of clover, consisting of 90 loads; and he thinks that 20 per cent of the present expence attending hay-making may be saved. It is recommended to construct corn ricks in the same way.

Agricultural thermometer.—When the danger of heating, or of actual combustion, is apprehended, the usual method of observing the changes of temperature is, by thrusting a stick into the stack; but, as the result of this experiment is vague and uncertain, the increase or diminution of heat can be precisely ascertained by means of a thermometer invented by Mrs Lovi of Edinburgh. This thermometer is so constructed, that it can be introduced into the stack, and the precise temperature discovered before it be withdrawn; and in this way the progress of the injury can be watched, and the necessity of turning over the stack distinctly indicated. If the temperature increase rapidly, and to a high degree, combustion may be dreaded, and the means of prevention must be expeditiously adopted; but if the temperature, after several trials at short intervals, shall appear to be on the decline, the labour and expence of opening up the stack may be avoided.

Sect. VI. *Of Pasture Lands.*

Under this head are included such lands as are retained in the state of grass for a limited time, and form part of the rotation with grain crops; such as are kept permanently under an herbage crop; and such whose inequality of surface, or elevation, precludes all tillage operations whatever.

The general directions, which are applicable to all pasture lands, refer to manuring in the way of top-dressing, when that is necessary; the extirpation of weeds; the removal of ant and mole-hills; the period of admitting live-stock in the spring, and of excluding them in the autumn; the quantity of stock introduced, and whether they should be all of the same or of different species; the advantages and disadvantages of feeding close, and the size and number of inclosures. In some of the best grazing counties of England, moderate sized inclosures are preferred; and Mr Marshall recommends, that in all cases where fattening cattle or dairy cows form part of the stock, and where situation, soil, and water permit, every suite of grazing grounds should consist of three compartments;—one for head-stock, as cows or fattening cattle; one for followers, as rearing and other lean stock; and the third to be shut up to freshen for the leading stock. A copious supply of water in every inclosure is of great importance to every kind of stock; and, in the formation of drinking pools, the attention should be directed to construct them in such a manner, that there may be no danger of young animals falling into them. The time of opening pastures in the spring must be regulated by the progress of the season. Old pastures may be stocked earlier than new formed grass grounds. Different kinds of stock are recommended for the same pasture, because the herbage which seems to be disliked and rejected by one species is eaten up by another. Although the greatest injury to pasture grounds arises from over-stocking, yet close feeding is, in many cases, advantageous, not only in preserving a fine close sward, but also in keeping down the coarser herbage, which otherwise might soon exclude much of the sweeter kinds of grass.

The general management of hilly or upland pastures, which are too rugged or too elevated to be brought under arable culture, is directed to draining, inclosing, and sheltering; and it seems probable that much of the land of this description is susceptible of great improvement by these operations judiciously conducted.

Chap. VIII. Of Live-Stock.

The returns to the agriculturist are derived from the grain crops raised on the possession, the produce of the dairy, or from the animals reared and fattened for the market. Local circumstances, no doubt, usually regulate the extent to which these different branches of rural economy are carried. Where arable culture is practised, working stock becomes necessary; and the productions of the dairy, to a certain extent, and some portion of animal food, are consumed by the family and servants of the occupier. The addition of manure to the exhausted soil, is an essential requisite; and this can only be obtained from the consumption of straw and green crops by live-stock. To conduct the whole of this complicated arrangement, demands great attention; and no small degree of skill and sagacity is required in selecting the best breeds of animals, whether for the purpose of labour, of the dairy, or of fattening; in selecting such as shall afford the most ample returns at the smallest expence, and in directing the mode of feeding and management to the most abundant production of manure. Mutually aiding and dependent on each other, the combination of the different departments of rural economy, in such proportion and extent as the soil, situation, and demands of the market admit, undoubtedly holds out the best and most profitable system for the occupation of land. In the following sections we propose briefly to treat of the more important domestic animals connected with rural affairs.

Sect. I. *Of Horses.*

Among domestic quadrupeds, the extensive utility and various excellencies of the horse, entitle him to the preference; and in estimating the qualities which render him valuable for agricultural purposes, strength, hardiness, activity, and true draught, are the chief points of attention. These properties exist in the Lanarkshire or Clydesdale breed of horses, the Suffolk punches, and the Cleveland bays. The Clydesdale horse is remarkable for his strength, and is peculiarly adapted for hilly countries; the Suffolk punch-sorrels, so called from their colour, are considered as the best cart horses in England, and are well fitted for undergoing long continued labour; and the Cleveland bays, which are reared in Durham, Northumberland, and Yorkshire, are of large size and fine mould, and possess great strength and activity. The Highlands of Scotland, and the mountains of Wales, produce a peculiar kind of small horses called *poneys*, which are reared with advantage in these coarse pastures, are much esteemed for neatness of shape and agility of motion, and are extremely hardy and sure-footed.

Breeding.—Farmers sometimes find it advantageous to rear their own horses, because the animals, when they are accustomed to the climate and pasture, are less liable to disease. Breeding mares may be gently worked for the sake of exercise, and ought to be well fed, and kept in good condition at all seasons, otherwise their offspring is apt to be weak and unhealthy. It is of great importance that the foal be not dropt too late in the season. Foals may be allowed to run with the mothers till September or October, or even later, in a mild season. When they are weaned, they should be kept in a stable, with a low rack and manger. Sweet hay, after-math, green clover, bruised barley or oats, bran and barley dust, are the best kinds of food for young foals. Foals should be carefully protected from cold and wetness; but it is highly beneficial, in mild weather, to admit them for a few hours daily into a dry and sweet pasture, where water is in abundance, and easily accessible. By this management, the young animal acquires habits of gentleness and docility, is more easily trained, and submits more quietly to labour. A horse intended for breeding should not be employed in work till he is 4 years old; no stallion ought to be kept for this purpose beyond the age of 18, and no mare should be allowed to breed after that period. Some experienced breeders are of opinion, that colts castrated at the age of three months, run less risk of inflammation than at a more advanced age; but, on the other hand, it is supposed, that by deferring the operation to the age of 18 months, or two years, the animals retain a greater degree of health and spirit.

Feeding.—The feeding of horses must always be an important object. Experience has amply shewn, that soiling with clover, tares, lucern, or other green food, instead of turning them out to grass, not only preserves them in the best condition, but is, at the same time, the most economical system of management. When they are well littered, the manure which is prepared almost repays the expence of their feeding. As winter food, carrots and Swedish turnip are cheap and excellent substitutes for oats. The use of carrots, it is said, is peculiarly beneficial in recovering broken-winded horses, provided the disease be not of too long duration. The best method of using grain for the food of horses is by bruising or boiling it; and hay or straw cut into chaff, potatoes, steamed or boiled, and mixed with a portion of bruised barley and barley-dust, are far less expensive than hay and corn, as winter food, while they are equally efficient in keeping them in good condition.

Stables.—Close stables, with separate stalls, where each horse can feed and repose without risk of being annoyed or disturbed, are recommended by some, while sheds with an open front, and furnished with

Live Stock.

a low manger and cattle rack, are considered by others as affording sufficient protection. During mild weather, and in a sheltered situation, this system of management is highly conducive to the health of the animals. They thrive better, are less susceptible of cold, are supposed to arrive at a greater age, and to continue longer fit for labour than when they are confined and shut up in warm stables.

Sect. II. *Of Cattle.*

The wild breed of cattle, which are now confined to Chillingham Park, in Northumberland, and Hamilton wood, in Lanarkshire, are supposed to be the origin of all the varieties which at present exist in Britain. The flesh of these animals is distinguished by its fine quality and exquisite flavour. This breed is remarkable for elegance and beauty of form; and, with the exception of the muzzle and extremity of the tail, the tips of the horns and hoofs, which are black, the colour is uniformly of the purest white.

The Devonshire breed is descended from this race. They are of a light red colour, have fine skins, are not large in size, but are hardy and well fitted for the draught, are not great milkers, but fatten early. The Hereford and Sussex cattle are nearly of the same colour, and possess similar properties, but afford greater abundance of richer milk. The Dutch or short-horned breed, which are much esteemed in the eastern counties of Britain, yield large quantities of rich milk and fine butter, fatten kindly, but are of a delicate constitution. The Lancashire breed is distinguished by long horns, thick hides, long close hair, coarse thick necks, and large hoofs; they are of various colours, but have generally a white streak along the back; they are of a hardy character; they milk sparingly, but the produce throws up a very rich cream. The celebrated Dishley breed is an improved variety of the Lancashire cattle. Their chief characteristics are, that they are smaller and cleaner boned, and fatten early and kindly, but the quantity of milk and tallow is deficient.

The Galloway breed, so named from the county in Scotland where they are chiefly reared, or the *polled* breed, as they have no horns, are in much repute among the English graziers, who annually purchase vast numbers for the supply of the markets of South Britain. They fatten well, and their flesh is of an excellent quality. This breed has been introduced into Suffolk, and are known by the name of Suffolk *duns*. The abundance and richness of their milk render them highly valued as dairy cows. The Dunlop or Ayrshire breed, so denominated from the name of the parish and county in which they were first reared, are supposed to be the offspring of Alderney cows and Fifeshire bulls. They are of small size, of a mixed red and white colour, and are more valued for the quality than the quantity of milk which they afford; but they continue to milk with little diminution, excepting about six weeks or two months, throughout the year. The Highland breed, or Kyloes, a hardy race, are chiefly reared in the Western Highlands, from which they are sent in vast herds to the southwards to stock the rich pastures of England, and to be fattened for the market, where the delicacy and flavour of their flesh have brought them into great demand. The Isle of Skye breed is a small variety of the kyloes, remarkable for its speedy fattening.

Live Stock.

Rearing.—In rearing live-stock of all descriptions, it ought to be an invariable rule to breed from small boned, straight backed, kindly skinned, round bodied, or barrel-shaped animals, with clean necks and throats, and little or no dewlap; and while the carcase is deep and broad, the least valuable parts, as the head and bones, should be small. In the selection of live-stock, such as have been accustomed to rich pastures should not be confined to those of an inferior quality, where they are apt to fall off, and occasion material loss. Animals of a quiet and docile temper, requiring less food, and being more easily fattened, ought to be preferred; and the valuable quality of early maturity, which is remarkable in some breeds, is too important to be overlooked. In the management of cows which are kept for breeding, it is to be observed, that about a month or six weeks previous to the time of calving they should be abundantly supplied with the richest kind of food. By this management, it is found that a larger quantity of milk is obtained than when they are fully fed for a longer period. For a day or two after the cow has drept her calf, her drink should be only lukewarm water, and she ought to be little exposed to cold or wet. The hardness of the udder may be removed by frequent milking, at least three or four times a day, and oftener if necessary, and by occasional gentle rubbing with soft ointment; but fomentation with flannel cloths, wrung out of hot water, and applied as warm as the animal will bear it, is probably a speedier and more effectual remedy.

Feeding and fattening.—Live-stock are supported by grazing in pasture lands; by *soiling* in proper yards or *sheds*, where they are supplied with luxuriant green crops; or by *stall-feeding*, where they are furnished with cabbages, turnips, and other food of a succulent nature, combined with various kinds of dry meat. When the grazing system is pursued, cattle should not be admitted into the pastures too early, or till the grass be so far advanced as to afford a sufficient supply of food. Much caution is necessary in changing the food of live-stock; and perhaps in all cases, even when it is of a richer quality, and more abundant in quantity, the change should be slow and gradual. A copious supply of pure water should always be within the reach of live-stock, as nothing contributes more to their health and vigour.

The advantages of soiling, or folding cattle in yards or sheds, which is strongly recommended by those who have practised it, are not yet, perhaps, fully appreciated. By this mode of feeding cattle, they are better protected, and less harassed with insects; the food is consumed with less waste; and when the yards are furnished with abundance of litter, as should always be the case, a large supply of excellent manure is obtained. But to have the fullest benefit from this mode of feeding, it is necessary to have convenient sheds and yards for the purpose; to provide suitable crops, in proper succession, to the proportion of stock; to conduct the feeding and general management of the animals in a clean and regular manner; and always to have a full supply of materials for litter. It ought not to be forgotten, that cattle managed in this way ought to have plenty of pure water, that they may have an opportunity of drinking whenever they are disposed; and it would, no doubt, be a most beneficial practice to turn them out into the open air for a few hours, in the cool of the evening in summer, or for a short time in the middle of the day when the season is colder. Varying the kind of food occasionally, when different kinds can be obtained, may be of considerable advantage.

For the purpose of fattening cattle in the winter, stall-feeding is resorted to. In this way they are kept more quiet and free from interruption, and feed more quickly, and with more regularity. The succulent kinds of food employed for this purpose are, turnips, potatoes, carrots, cabbages, grains, &c. and those of a dry description are, oil-cakes, oats, barley-meal, bean-meal, and other substances, with different kinds of straw, cut into chaff, by means of machinery. In stall-feeding, warmth and cleanliness are of great importance; and when both moist and dry food is employed, it should be combined in such proportions that the injurious effects of one species on the digestive organs of the animal, may be counteracted by that of another. The proportions of the different kinds of food must depend on the mode of feeding, the size of the animal, and the nature of the season.

Sect. III. *Of the Dairy.*

The situation of a dairy should be such that the lattices front the north, north-west, or north-east; and the lattices, which are preferable to glazed lights, may be covered with oil-paper, pasted on pack-thread, by which the light is admitted and the sun and air excluded. The utmost cleanliness is requisite in the whole management of the dairy; and, to attain this object, separate apartments, communicating with each other, are allotted for the reception and scalding of milk, for keeping and cleansing the vessels, and for making and preserving butter and cheese. The dairy should be paved with stone or brick, having a gentle inclination, and the pavement should be daily washed in summer. To preserve the air cool, it is recommended to have the dairy-house near a cold spring or rivulet, or by conducting a small stream of water into the apartments, to let it fall from some height on the pavement. The utensils, which are usually of wood, must be washed with the greatest care; or if metallic or glazed earthen vessels be employed, they ought to be daily scalded, scoured with salt and water, and well dried before the milk is poured in. Cast-iron vessels, glazed or enamelled in the inside, which are manufactured at the Shotts iron works, in Lanarkshire, have been lately introduced into the Scottish dairies, and are found to answer well, both on account of their cleanliness and durability.

1. *Making Butter.*

The quality as well as the quantity of a cow's milk, depends greatly on the nature of the food of the animal; but the quantity is also affected by the mode of milking. Much attention is necessary in managing this operation; and if any difficulty occur, the animal should never be treated harshly, by which the flow of the milk is diminished or interrupted. The hardness and pain of the udder, which sometimes produce this effect, are removed by fomentation with warm water, and gentle friction, and the flow of milk is restored. Cows are usually milked twice in the twenty-four hours; but in summer, three times a-day, at equal intervals, are necessary. The quantity of milk is thus increased, and the quality is not worse. The milk drawn from the cow is strained through a linen cloth or hair-sieve, into the cream-dishes, the depth of which should never exceed three inches. To remove the ill flavour which milk is apt to contract from the cows feeding on turnips, it is recommended to add 1-8th of boiling water to the milk before it is poured into the dishes. The ill flavour of milk, it is said, is also obviated, by boiling two ounces of nitre in a quart of water, and when cold adding a tea-cup full of the mixture to 10 or 12 quarts of milk from the cow.

Quality of milk.—The first drawn milk is thinnest, and of inferior quality. The cream which rises first is richest in quality and greatest in quantity. Thick milk affords the smallest proportion of cream, but it is of the richest quality. Milk diluted with water produces more cream, but the quality is injured. When milk is carried about in pails, or agitated and cooled before it is poured into the milk-pans, the quantity as well as the quality of the cream is diminished. From these facts, it appears of importance that cows should be milked near the dairy, to prevent the milk being carried and agitated; and it should be recollected that cows are hurt by being driven from a distance before milking. The practice of putting the milk of all the cows into the same vessel, before it is distributed into the milk-pans, is regarded as highly injudicious; both because the agitation and cooling are injurious, and because the quality of each cow's milk cannot be ascertained. If the milk of each cow were kept in a separate pan, the quantity afforded every day, as well as its peculiar qualities, would be easily determined. To have butter of a fine quality, the milk of all those cows which yield cream of a bad quality, ought to be rejected, and the last portion of the milk drawn only should be employed.

Churning.—The chief secret in the management of the operation of churning, whatever be the form of the apparatus employed, is to continue the agitation with the same regular, uniform, and uninterrupted motion, from its commencement to its termination; and to insure this uniformity, even the aid of an assistant, except in cases of absolute necessity, should be avoided; because too rapid or unequal motion, in summer, communicates to the butter an ill flavour, and in winter the process is interrupted or entirely fails. A table-spoonful or two of distilled vinegar, added to the cream, after it has been a good deal agitated, it is said, speedily promotes the separation of the butter.

When the butter is formed, it is usual to wash it in several waters till all the milk is separated; but it is better to squeeze out the milk by means of a flat wooden ladle with a short handle; or to spread it thin on a marble slab, and the remaining moisture may be easily taken up, by pressing it with clean, dry towels; and as washing with cold water injures the flavour, it may be cooled, and rendered sufficiently solid to retain the impression of the mould, by floating it in small vessels in a trough of cold water.

Salting.—Butter is usually preserved for future use by means of common salt. The following preparation, proposed by Dr Anderson, is an excellent substitute for common salt in curing butter, and imparts to it a richer and sweeter taste. Two parts of good common salt, one part of loaf sugar and one of saltpetre, are pounded and well-mixed together. One ounce of this mixture is well incorporated with every pound of butter, which is then closed up in a proper vessel, and at the end of two or three weeks, before which time it should not be used, it is fit for use. Thus prepared, it retains all its sweetness and flavour for two or three years.

The best and highest flavoured butter is made in summer; but it is said that a small portion of the expressed juice of the pulp of carrots, added to the cream before churning, communicates to winter butter the fine colour and rich flavour of what is made in summer.

Dutch butter.—The method of making butter in Holland is, to allow the milk, after it is drawn from the cow, to be cold before it is put into the pans; to prevent the cream from separating from the milk, by stirring it two or three times a day with a wooden spoon; and when it is sufficiently thick to churn it for an hour. When the butter begins to form, a quantity of cold water is poured in, for the purpose of separating the butter from the milk; and when the butter is taken out, it is washed and kneaded till the last water passes off pure. Milk managed in this way, it is said, yields a larger proportion of butter, which is firmer, sweeter, and keeps longer than by the ordinary method practised in this country; and the butter is also stated to be of a better quality.

2. *Cheese-Making.*

The excellence of cheese, it is not improbable, depends a good deal on the quality of the milk; but the season of the year in which it is made, and the management of the necessary processes, are not of less importance. The best season is from the beginning of May to the end of September, or, when the weather admits the pasture to be open, to the middle of October. In some large dairies the manufacture continues throughout the year; but winter-made cheeses are of inferior quality.

Rennet.—The rennet which is employed in coagulating milk is prepared with the stomach or *maw* of young calves. The curd found in it is thrown away; and after the bag has been steeped in pickle it is stretched out and dried, after which it will keep for a long time. An inch of the dried maw, steeped in a few spoonfuls of warm water the night before using it, will serve to coagulate the milk of five cows. But as the rennet by this simple preparation is apt to become rancid, greater attention is necessary to keep it in a sound state. The method of preserving it in the West of England is, when the rennet bag is cleaned, to make a strong solution of salt with two quarts of water; to add to this solution small quantities of all kinds of spices, and to boil the whole slowly down to three pints; then to strain the liquor and pour it on the rennet bag; to add a sliced lemon; and having stood at rest for a day or two, to strain it and bottle it for use:—when well corked, it will keep for a year, or longer, and communicate to the cheese a pleasant aromatic flavour. A decoction of the flowers of yellow ladies bed-straw, or cheese-rennet, *galium verum*, a common plant in many pastures, and muriatic acid, or spirit of salt, when judiciously managed, are successfully employed as efficient substitutes. The peculiar pungent taste of Dutch cheese is ascribed to the use of the latter substance in coagulating the milk.

Colouring.—Spanish arnotta is the substance in most common use for colouring cheese; and it is employed in different proportions according to the shade required. In Gloucestershire an ounce is allowed for every hundred pounds of cheese. The poorest cheese requires the largest proportion. The method of using it in Cheshire is to tye up the necessary quantity of pounded arnotta in a linen rag, and to infuse it in half a pint of warm water the night before it is wanted, and next morning, before the application of the rennet, to mix the coloured infusion thoroughly with the milk; or, as it is practised in some places, a piece of the unpounded arnotta, dipped in milk, is rubbed on a smooth stone, and the colouring matter thus obtained is combined with the milk in the same way.

Cheshire cheese.—The cream of the preceding evening's milk is skimmed off and poured into a pan heated with boiling water, and a third part of the same milk is heated in the same way. The new milk of the morning and that of the preceding evening being thus prepared, are introduced into a large tub along with the cream. The colouring matter first, and then the rennet, after the necessary preparation, are added. The whole is stirred together and covered up warm till it is curdled, is then turned over with a bowl to separate the whey, and soon after the curd is broken into small pieces. The whey is removed and the curd is cut into slices, and repeatedly turned over and pressed with weights to separate the remaining portions of whey. The curd removed from the tub is broken by the hand into small pieces, put into a cheese vat and strongly pressed, transferred afterwards into another vat, or returned into the same, after it has been well scalded, and the process of breaking down and pressure is repeated. The cheese is then removed into a third vat, previously warmed, with a cloth beneath it, and a tin hoop, or binder, put round the upper edge of the cheese and within the sides of the vat, the former being enclosed in a clean cloth, and its edges placed within the vat. The processes now described occupy a period of six hours, from seven in the morning till one in the afternoon; and eight hours more are necessary for pressing the cheese, during which time it should be twice turned in the vat. The succeeding morning and evening it is again turned and pressed, as well as on the morning of the third day, about the middle of which it is removed to the salting apartment, where the outside is well rubbed with salt, and a cloth binder is passed round it. During a week, while the cheese remains here, it is turned twice a day, and as it is left for some days longer to dry, it is turned once, and well cleaned daily. It is then transferred to the store-room, which should be moderately warm, and protected from a current of air, to avoid the risk of cracking, and turned every day till it become firm and dry.

Gloucester cheese.—In making Gloucester cheese the milk is used as it is drawn from the cow; and if it be too hot in summer, the temperature is reduced by adding skim milk, or water. After the application of the colouring matter and the rennet, the formation of the curd, and breaking down the latter with the hand and a double cheese knife to separate the whey, the curd is put into vats and pressed for a quarter of an hour. It is then turned into cheese tubs, and again broken small, scalded with a pail full of water, lowered with one part of whey, and the whole is briskly stirred. Having stood a few minutes to allow the curd to settle, the liquor is strained off, and the curd is collected into a vat. When the vat is half full, a little salt is sprinkled on and well wrought into the cheese; the vat is filled up; the whole mass is turned two or three times round; the edges are pared, and the middle rounded at each turning. The cheese, surrounded with a cloth, is again subjected to pressure, is then removed to the shelves, and turned daily, till it be sufficiently firm to admit of being washed.

Stilton cheese.—The method of making this cheese, as it is described in the Agricultural Report of Leicestershire, is the following: The night's cream is put into the morning's new milk, with rennet, and when the curd is come it is not broken, as is done with other cheeses, but taken out whole and placed in a sieve, to drain gradually, and as it drains, a gradual pressure is continued till it becomes firm and dry. It is then placed in a wooden hoop, and afterwards kept dry on boards, and turned frequently with the cloth binders round it, which are tightened as occasion requires. When the cloths are removed, each cheese is rubbed with a brush once every day, and in damp weather twice, for two or three months. The same thing is done daily to the tops and bottoms of the cheeses before the cloths are removed.

Cream cheese.—This kind of cheese is usually made in August or September, when the milk is richest. As the warmth of the season is insufficient to ripen it, a greater thickness is given to this kind of cheese, that it may retain its mellowness. In the preservation of cream cheeses, a warm situation should be selected, and the precaution of securing them from frost should be strictly observed, otherwise the rich quality of the cheese is lost, and it becomes insipid or ill tasted.

Dunlop cheese—Is so called from being made in a parish of the same name, in Ayrshire in Scotland. When the milk is brought to the temperature of 90° in summer, and above 100° in winter, it is poured into a large vessel, and the rennet being added, it is covered up closely for about ten minutes. With good rennet the milk is then coagulated, and by gently stirring it the whey separates, and is removed as it collects, till the curd become tolerably solid. The curd, placed in a drainer, is pressed down with weights; and having remained for some time till it is dry, it is returned into the first vessel, where it is cut into small pieces with a knife, composed of three or four blades, which cut horizontally. It is then salted and properly mixed by the hand, put into a strong dish with iron hoops, which has a cover that goes exactly into it; a cloth is placed between the curd and the vessel, and in this state it is subjected to the cheese-press, from which it is occasionally taken, and wrapped in dry cloths till the whey is entirely separated. The cheese is then laid aside for a day or two; and if, on examination, any appearance of whey remains, the pressure and application of cloths are renewed. The whey being extracted, the cheese is laid out on boards, which should be of the same breadth, or on a deal floor; and it should be occasionally examined, to remove any moisture that appears, turned occasionally, and rubbed with a coarse cloth, which may prevent the breeding of mites.

Parmesan cheese.—The process for making this celebrated cheese, which is a production of the rich dairies of Italy, is thus described: At ten o'clock in the morning, $5\frac{1}{2}$ brents of milk, each brent about 48 quarts, are put into a large copper, which turns on a crane, over a slow wood fire, made about two feet below the surface of the ground. The milk is stirred from time to time; and about 11 o'clock, when just luke-warm, or considerably under blood heat, a ball of rennet, of the size of a walnut, is squeezed through a cloth into the milk, while the stirring is continued. By the help of the crane, the copper is turned from over the fire, and allowed to stand till a few minutes past 12, at which time the rennet has operated. It is now stirred up, and left to stand a short time; part of the whey is taken out, and the copper again turned over a fire sufficiently brisk to give rather a strong heat, but below that of boiling. A quarter of an ounce of saffron is added to colour it, and the stirring is occasionally repeated. The dairyman frequently examines the curd, and when the small, and as it were granulated parts, feel rather firm, which is in about an hour and a half, the copper is removed from the fire, and the curd is left to subside; part of the whey is taken out, and the curd, brought up in a coarse cloth, is put into a hoop, and about $\frac{1}{2}$ cwt. placed upon it for an hour, after which the cloth is taken off, and the cheese placed on a shelf in the same hoop. At the end of two or three days it is sprinkled over with salt, and the same application is repeated every second day for about six weeks. During the process of salting, two cheeses are usually placed upon each other, in which way they are supposed to take the salt better than singly.

Keeping of cheeses.—Cheese should be kept in an airy situation. The leaves of tutsan, or park leaves, *hypericum Androsæmum*, or of the yellow star of Bethlehem, *ornithogalum luteum*, moderately dried, or the young twigs of the common birch tree, especially the latter, placed on the surface or sides of the cheeses, are found useful in preventing the depredations of mites. The *hoving*, or swelling of cheeses is ascribed to some imperfection in the process of making. Regular turning, and keeping such cheeses as have this tendency in a moderately cool, dry place, have the effect of interrupting or preventing its progress. When the swelling becomes considerable, it is necessary to prick it with an awl or pin in several places, by which the air evolved is allowed to escape.

Sect, IV. *Of Sheep.*

Sheep are a very valuable kind of live-stock, on account of the flesh, the wool, and other products. In many situations, the largest proportion, and in others the whole of the profits of the husbandman are derived from this kind of stock; and there are probably few possessions which may not afford some advantage in the view of breeding, grazing, or the fattening of their lambs.

The numerous breeds of sheep which are prevalent in this country, have been arranged into two classes; those which shear the short, or clothing, and those which shear the long, or combing wool. By others they have been divided into the mountain breed, the short-woolled, and the long-woolled breed. The first class includes the varieties which are reared in the mountainous districts of Wales, the north of England, and Scotland; the second comprehends those of Hereford, Dorset, Sussex, Norfolk, and some other places; and the last class embraces the varieties which occupy the richer and more fertile parts of England, and which are distinguished by the names of the Durham or Tees waters, the Lincolnshires and the Leicestershires.

Mountain sheep.—The mountain, heath, or, as they are sometimes called, black-faced sheep, from having black faces and legs, are a hardy active race, with large spiral horns and short firm carcases. They afford fine grained and well flavoured mutton, but the wool is open, coarse, and shaggy. They are usually fattened about the third or fourth year. The Cheviot breed has no horns; the face and legs are chiefly white, and the eyes are lively and prominent. This is a hardy race, affords fine wool, and is quick in fattening.

Short-woolled.—The Herefordshire sheep are small in size, have no horns, have white legs and faces, and fine short wool. This breed is also known by the name of *Ryelands.* They are remarkable for being patient of hunger, and it is said that no breed of sheep in the island can subsist on so small a portion of food. The South Down breed is also distinguished by the closeness and fineness of the wool; they have grey faces and legs, long small necks, and afford fine grained and well flavoured mutton. This is the prevailing breed in the dry chalk downs of Sussex. The wethers are rarely kept beyond the age of two years, and they are often fattened at 18 months. The Norfolk breed is distinguished by a black face, large spiral horns, and long black or grey legs; the wool short and fine, and the mutton fine grained and high flavoured.

Long-woolled.—The Lincolnshire breed, known also by the name of *Old Leicester,* is distinguished by want of horns, white faces, long, thin, weak carcases, large bones, slow feeding, coarse grained mutton, and wool from 10 to 18 inches in length. This breed thrives only on the richest pastures, and is chiefly valuable on account of the large quantity of wool. But it is from this breed that the *New Leicester,* or *Dishley* breed, which derives its name from the place where it was successfully reared and improved by the celebrated Bakewell, is descended. The Dishley breed is distinguished by its fine lively eyes, clean heads, without horns; straight, broad, flat backs; round or barrel-shaped bodies; small bones; thin pelts; a disposition to fatten at an early age, and fine grained, well flavoured mutton. The weight of the quarter, in ewes of three or four years old, is from 18 to 26 lbs.; in two year old wethers, from 20 to 30 lbs.; and the length of wool is from 6 to 14 inches. The excellence of this highly improved breed consists in their fattening more speedily, and with a smaller consumption of food than almost any other; in having a larger proportion of meat on an equal weight of bone; in thriving well in pastures which would not support other kinds of the same size; in more valuable wool; in being ready for the market early in the spring; and, from all these properties, affording a greater profit. The Tees-water breed have longer legs, finer bones, and a thick and firmer carcase, than the Lincolnshire; the mutton is fatter and finer grained, and the wool is shorter and less heavy. This is the largest breed in the island, and is the most common on the rich inclosed lands on the banks of the river Tees in Yorkshire, from which it has received its name. It seems to be only calculated for warm, well sheltered pastures, and requires to be well fed in severe winters. A large weight of mutton is obtained from this breed, but it is longer in coming to maturity, and requires a larger portion of food, so that it is less profitable than those of a smaller description. The Romney-marsh breed has no horns, has white faces and legs, which latter are long; the body rather long, but well barrel-shaped, and bones rather large. The wool is fine, long, and of a delicate white colour. This breed arrives early at maturity, and succeeds well on the richer kinds of pasture. In the *Merino,* or Spanish breed of sheep, the males have horns, but the females sometimes have none; the faces and legs are white; the shape of the body not very perfect, and the legs are rather long. It is fine boned, and the pelt is clear and fine. This breed is also well known to be remarkable for the fineness of its wool; it is also pretty hardy, and has a disposition to fatten readily. But for a detailed account of the different breeds of sheep, as well as for the general management, the reader may consult with advantage, Culley on *Live-Stock,* Parkinson on *Live-Stock,* and Dr Parry's *Memoir on Breeding and Feeding Sheep, in Communications to the Board of Agriculture,* Vol. V.

Sect. V. *Of Swine.*

Some diversity of opinion exists with regard to the benefit arising from the breeding and rearing of swine, conducted on a large scale; but of the advantage afforded by this kind of stock, when kept within moderate limits, and managed as a secondary concern, no doubt can be entertained. The expense of rearing and feeding swine to a certain extent is small, while the profit is considerable. It has been observed by a writer in the Farmer's Magazine, who has had much experience in rearing this kind of stock, that a farm of 300 acres, of which 200 are kept under tillage, might, by proper management in the rearing of swine, afford L.100 Sterling of annual profit. A very small capital is required in this branch of rural economy, and the trouble and expense which attend it are trifling. It is stated by the same writer, that it is the most beneficial stock which can be introduced on a farm, as long as the number kept exceeds not the extent of offals produced on the possession.

Numerous varieties of this animal are reared in Britain. The Berkshire breed is of a reddish colour, with short legs, large ears, and a thick, close, well-made body; is readily disposed to fatten, and grows to a large size; but the supply of food must be constant and abundant. The Chinese, or black breed, is of small size, short legs, and thick, close, well made body; is considered one of the most profitable breeds in the country; the flesh is delicate, and it fattens kindly, even on indifferent food. The Gloucester breed is of a white colour, and large size; is ill formed, and considered unprofitable. The Hampshire breed is also white, has a large body, fattens kindly, and attains a great size. The Highland, or Irish breed, is of small size, and ill shaped; is regarded as an inferior kind, for it thrives indifferently. The Northampton breed is remarkable for the enormous length of its ears; is of a large size, but does not fatten very kindly. The Rudgwick breed is reared at a village of the same name, on the confines of Surry and Sussex; is a valuable variety, fattens readily, and to a large size. The large spotted Woburn breed is a new variety, introduced by the late Duke of Bedford; the colour is various and the size large; it is well formed, prolific, hardy, and kindly disposed to fatten, attaining nearly twice the size and weight of other hogs within the same given period. The reader who wishes to have a full and satisfactory account of the method of feeding swine, and of curing pork and bacon, is referred to the *Complete Grazier*; or to Henderson's *Treatise on Swine*.

Chap. IX. Of Farm-offices, Leases, &c.

In concluding this treatise, a few general remarks on the situation and requisite accommodation of a dwelling-house and farm-offices, on leases and rent, may be useful.

Sect. I. *Of Farm-Buildings.*

Situation of farm-offices.—The situation and general arrangement of the necessary buildings of a farm-steading, have been oftener directed by accident than by attention to convenience or local advantages. When other circumstances admit, the most centrical situation on the possession ought always to be selected; but where a dry, sheltered, and healthy spot presents itself, and having, at the same time the command of abundance of water, for the purposes of domestic economy, or of driving machinery, some deviation from the general rule may be admitted. With regard to the general arrangement of the different buildings of farm-offices, it is recommended to select the three most exposed sides of a square for them, while the southern aspect is left open to the sun and air. While it is considered advantageous to erect the dwelling-house at a small distance from the offices, it may be equally beneficial to have the ordinary sitting-room so arranged as to command a view of the farm operations, both in the immediate vicinity and in the fields. The windows of this apartment should have a full view of the chief approach to the yards, cattle, &c. and when it can be accomplished, should also be directed to the farm-yard.

Farm-offices.—The judicious disposition of the offices of a farm, is a very important object of rural economy. Distinct buildings are necessary for the various sorts of cattle, and other purposes; and the general distribution and relative position of the whole, should be so arranged as to suit the convenience, and facilitate the labour of the attendants. The bottom of the yard should be quite level, and bedded with some substance which renders it impenetrable to water, that liquid animal matters may not be absorbed and lost. In erecting feeding-houses, or ox-stalls, their situation, which ought to be dry, and not too much exposed to the sun, demands particular attention. The floor should be paved, and have a gentle slope. The stalls are from seven to nine feet wide, according to the size of the animals. Cows require the same space, for the convenience of milking, and of suckling their calves; but the stalls should never be so wide as to permit the cattle to turn round in them, by which accidents sometimes happen. These may be obviated by placing a post in the middle of the stall, immediately before the shoulders of the cattle. A regular temperature, and a proper circulation of air, are preserved by means of windows furnished with shutters, which are opened or closed according to the state of the weather.

In the construction of stables, a dry airy situation should be selected, and the buildings should be furnished with shutters, to exclude the light in the day-time, when necessary. With regard to the pavement of stables, it is recommended to cover that part on which the horses lie down, with oak boards, arranged transversely upon a level, and pierced with holes, for conveying the urine from the stall-drain into the main-drain. The other part, paved with small stones, has a slope towards the perforated boards. The ordinary construction of mangers and racks is faulty and inconvenient, in allowing a needless and excessive waste of provender, and exposing the animals to injury, from hay seeds falling into their eyes and ears. The barn is an essential building on farms where corn husbandry is practised, which should be in a dry situation, with a firm dry floor, well ventilated, and sufficiently spacious for the extent of the possession, or the amount of the produce. A building for the reception of carts and implements which are not in immediate use, is also requisite, to protect them from the weather. A building of this description should be so contrived, as to afford complete shelter from the rain, while a free circulation of air is admitted. A smaller apartment should be appropriated for the numerous smaller tools and implements; and it may be added, that no implement should be deposited before being cleaned, dried, and completely repaired, so that it may be always in readiness for future use. The construction of calf-pens and piggeries, also merits attention; and where the feeding of live stock is extensively carried on, the commodious situation of the straw and root-houses, and of the necessary appendages of a steaming apparatus, should be particularly studied, in the view of saving time, and avoiding waste. The arrangement and management of the dunghill, which is always an object of the utmost importance, has been already described in the chapter on manures.

Sect. II. *Of Leases and Rent.*

Few subjects in agriculture are more important, or attended with more difficulty, than the proper mode of fixing the duration of leases, and the amount of rent; for, with these points, the mutual security and prosperity of both landlord and tenant are very closely connected.

Leases.—With regard to leases, it may be observed, that when they are of short duration, and clogged with injudicious restrictive clauses, they are equally injurious to the interests of the proprietor and occupier of land, and may be justly considered as the most serious obstacles in the way of all improvement.

The certain duration of a lease, on the one hand, becomes a powerful stimulus to the tenant to follow out that system which he conceives the most effectual for rendering the soil productive, and, on the other, restrains him from whatever mode of cropping he knows will render it unfruitful; and thus it appears to be of incalculable importance to individual benefit, as well as public prosperity. He who can look on his farm as his permanent residence, will naturally be led to every species of improvement. He will plant, and drain, and manure, in the hope that all such expenses will be ultimately and certainly repaid. Permanence and security of tenure being the great incitements to all improvement, Lord Kames proposes, that at the expiration of twenty-one years, if the tenant offer an adequate additional rent, with the view of continuing in the farm, the landlord may be at liberty to take it into his own occupation on paying to the tenant ten years purchase of this additional rent. This principle of renting land seems highly favourable to every kind of improvement; but it may be questioned, whether a less considerable purchase would not answer the intentions of such a lease. Could leases be formed on such a principle, the interests of the proprietor and tenant, instead of clashing, as they generally do in most instances, would be mutually increased. From the security afforded by such a tenure, the one is stimulated to additional exertion, while the other has the satisfaction of perceiving his land rapidly advancing to the highest state of cultivation. The genius of the farmer, in this way, is not restrained by restrictive modes of cultivation; and the income of the landlord is not diminished by the deterioration of his property.

Rent.—Various modes have been adopted for regulating and fixing the amount of rent. In most cases, the rent is valued and paid in money; but many intelligent agriculturists are of opinion, that great advantage would result to both tenant and landlord by the substitution of corn-rents; that is, by rents regulated according to the average price of corn in the market where the tenant disposes of his produce. By this means the landlord is secured of a just income, and the tenant pays rent in proportion to the actual produce of his farm. Should the landlord be satisfied with the character, circumstances, and enterprise of the tenant, the quality of the land requires only to be estimated by good judges; and should it appear to be of the first-rate value, the average produce is divided into three parts, one of which is given to the landlord, one to the tenant, and a third to the farm. This practice is very prevalent on the continent, but may be considered as only applicable to land of the very best and most productive quality. Supposing the land so let to produce twelve bolls of oats at an average per acre, the landlord would in this case receive from four to five pounds in a dear year, but in a cheap year only from forty to fifty shillings. As the value of corn-rents often varies considerably from year to year, it becomes necessary to calculate the average price during several years, otherwise corn-rent is suited only to leases of long duration; for experience proves, that when grain is scarce, and prices are very high, the landlord, in such seasons, has a much greater advantage than the tenant can have when the corn is abundant and the prices are low.

As land of inferior quality, however, requires not only a more expensive mode of cultivation, but also much skill, capital, and industry, to improve and keep it in a productive state, the fourth part of the produce may, in this case, be considered as the fair value of rent; and from the examinations of the most intelligent agriculturists lately before the Committee of the House of Commons, even the fifth part of the actual produce of land of the worst quality was deemed a sufficient return to the landlord. In all leases, therefore, founded on such principles, the quality of the soil must determine the proportion to which the landlord is entitled in name of rent, whether it be a third, a fourth, or a fifth part of the actual produce.

But the amount of rent may be determined according to the average price of labour, which fluctuates less annually than the money price of corn. If the average price of labour could be ascertained, many are of opinion that this would be the most invariable measure for rent, because it varies less from year to year than the price of corn, and is generally accommodated to the average price of all the necessaries of life. Were it as practicable to ascertain the money price of labour in every parish, as it now is to determine the fiar prices of grain in every county, it would be extremely easy to fix the price of rent according to this rule; and this might even be practised by every tenant calculating the average price of the wages he pays annually to all such labourers and servants as he employs on his farm. But a more eligible mode of fixing the rent would be, not by any one of these rules, but in a just proportion of all the three; that is, partly in money, partly according to the price of labour, and partly according to the price of corn. Thus, if the rent of a farm be valued at L.300 *per annum*, supposing the average price of a day's labour through the year to be two shillings per day, and the boll of corn or oats to be twenty shillings; the tenant, in this case, would pay the price of a thousand days labour, the price of an hundred bolls of oats, and one hundred pounds in money, per annum, during the currency of his lease.

Perhaps the best mode that can be devised for fixing the rent, is to make it payable according to a certain number of bolls of such grain as the land commonly produces, expressly declaring that the maximum shall not exceed a certain sum. Thus, if the farm be valued at L.500, the rent is converted into 250 bolls, or 125 quarters of wheat; and if the average or fiars price of the year be 30s. per boll, the

Leases, &c. rent will be L.375; but if the average price be L.2, then the rent will be precisely the stipulated sum of L.500; and if the fiars should rise to L.3 per boll, the rent can never exceed the stipulated amount of L.500.

For farther information on Agriculture, we refer our readers to Dr Coventry's *Introductory Discourses*;—Davy's *Elements of Agricultural Chemistry*;—Dickson's *Agriculture*;—*The Complete Grazier*;—and Brown's *Treatise on Rural Affairs*.

Explanation of Plates.

Plate 2. Fig. 1. Plan of a hill; and Fig. 2. Section of the same, for illustrating the principles of draining. Fig. 3. Plan of a land-locked bog; and Fig. 4. A section of the same bog, shewing the method of draining, by boring through the impervious stratum at the bottom. Fig. 5. 6. 7. 8. 9. 10. and 11. sections of different kinds of artificial drains.

Plate 3. Fig. 1. and 2. Rotherham plough; Fig. 3. and 4. Small's plough; Fig. 5. and 6. Improved harrows; Fig. 7. Drill harrow; Fig. 8. Drill barrow; Fig. 9. Section of a grubber; Fig. 10. Plan of the whole implement.

Plate 4. Reaping machines. Fig. 1. Perspective view of Mr Smith's in operation; Fig. 2. Perspective view of Mr Kerr's while at work.

Plate 5. Fig. 1. Improved thrashing machine, with fanners attached; Fig. 2. View of the feeding rollers of ditto, with the apparatus for reversing their motion, or for stopping them altogether; Fig. 3. Method of attaching a horse-power, when water is deficient; when the horse-power alone is employed, a segment of the water-wheel is taken off; Fig. 4. Plan of the patent hay-turner, or rotative rake; Fig. 5. Section of the same.

Errata in Agriculture.

P. 93. col. 1. line 11. for *tillage*, read *arable land*.
P. 131. col. 2. line 7. for *that his ploughs*, read *that two of his ploughs*.

INDEX.

DRAINING.

Fig. 1.

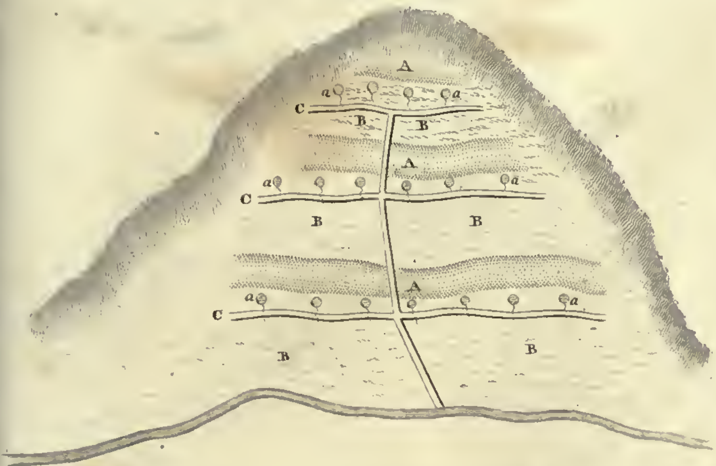


Fig. 2.

Fig. 3.

Fig. 4

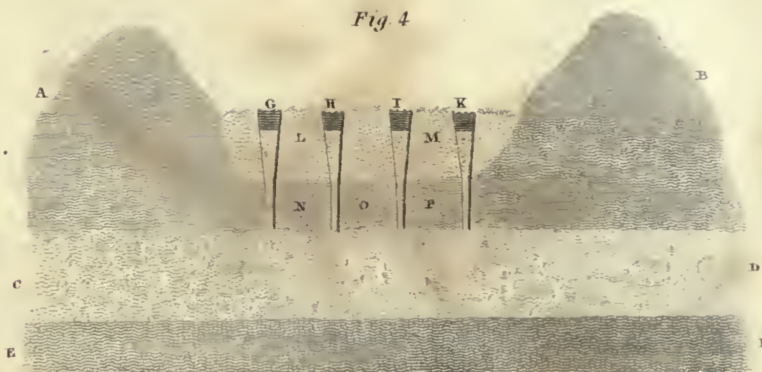


Fig. 5.

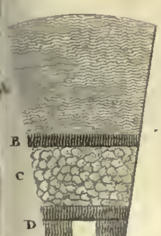


Fig. 6.

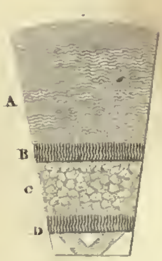


Fig. 7.

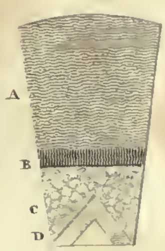


Fig. 8.

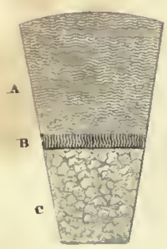


Fig. 9.

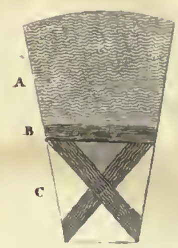


Fig. 10.

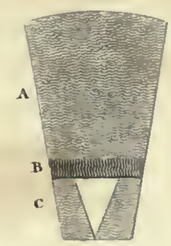
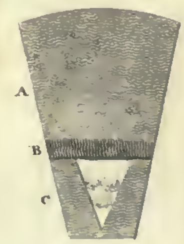
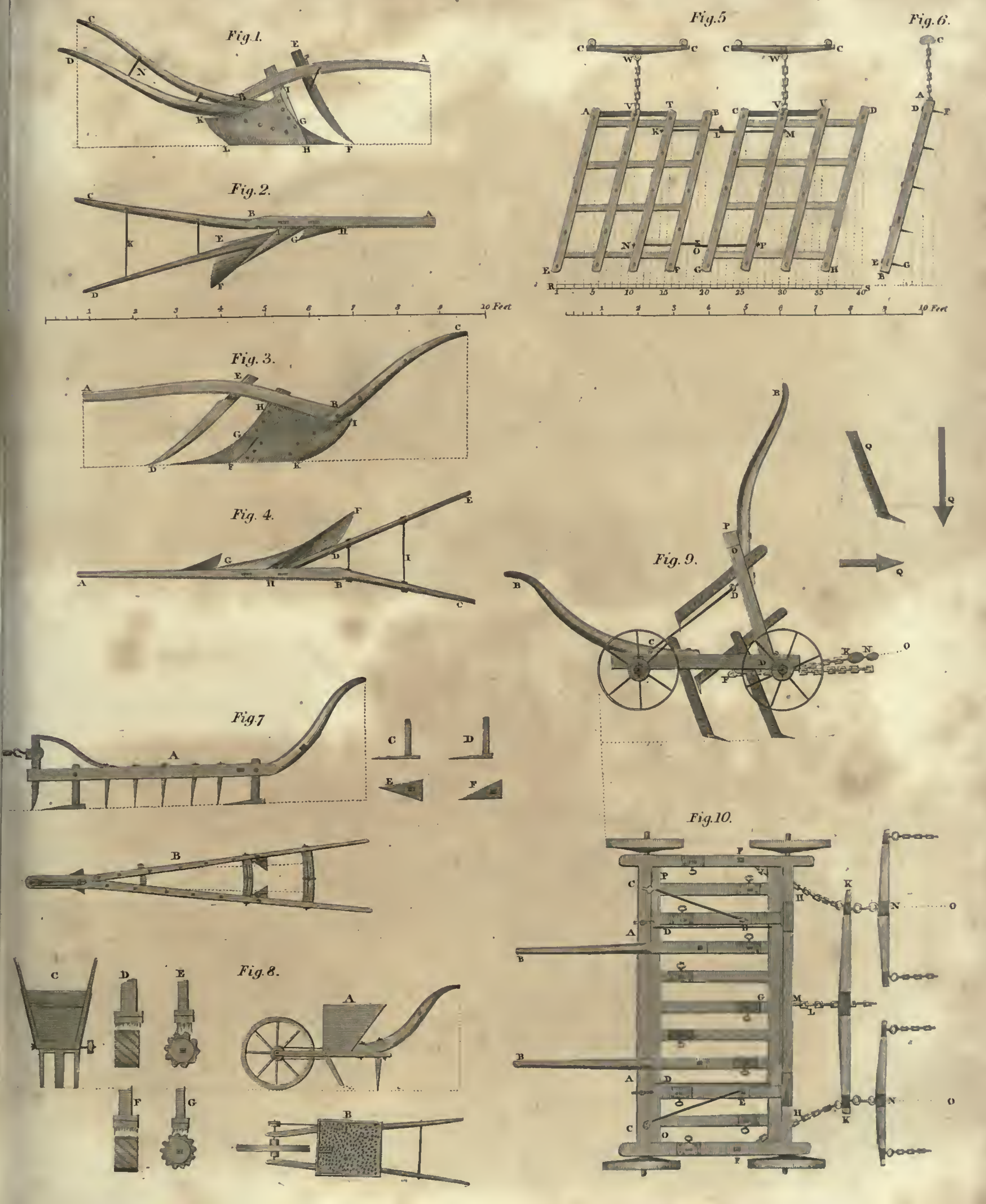


Fig. 11.



Eng.d by T. Clerk Edin.r

AGRICULTURE. PLATE. 3.



REAPING MACHINE.

Fig. 1. Mr. Smith's

Fig. 2. Mr. Kerr's

Drawn & Engraved for the Encyclopaedia Edinensis by W. & D. Lizars Edin.

THRASHING MACHINE.

Fig. 1.

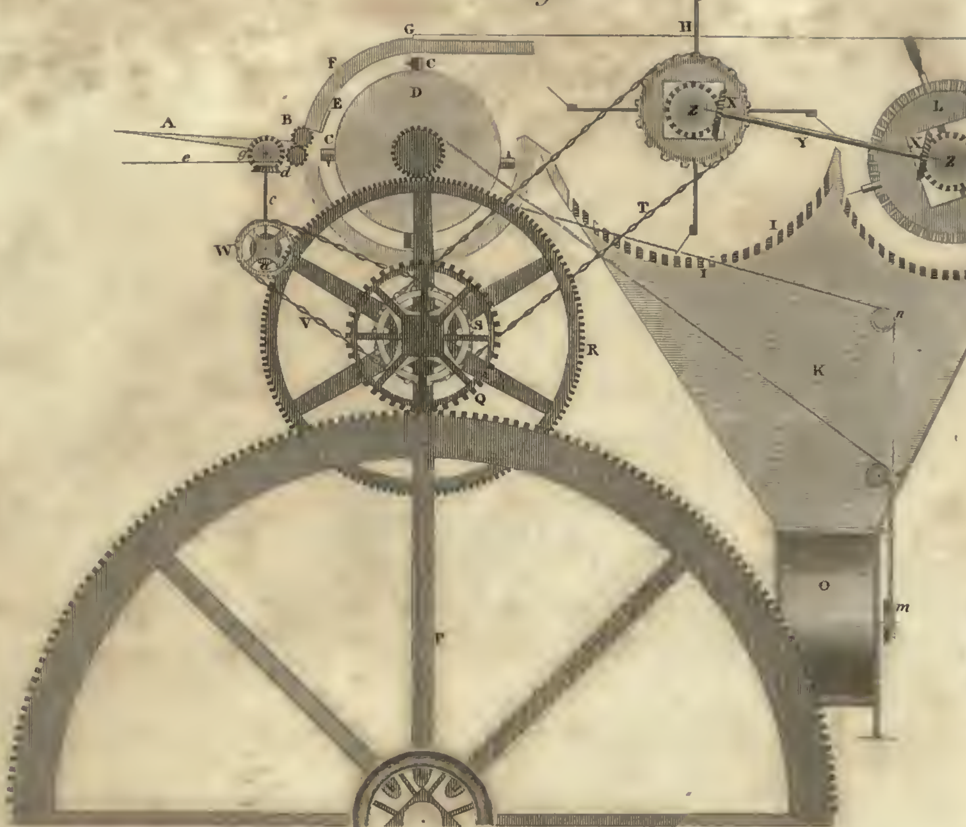


Fig. 3.

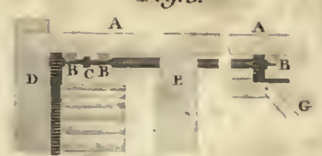


Fig. 2.

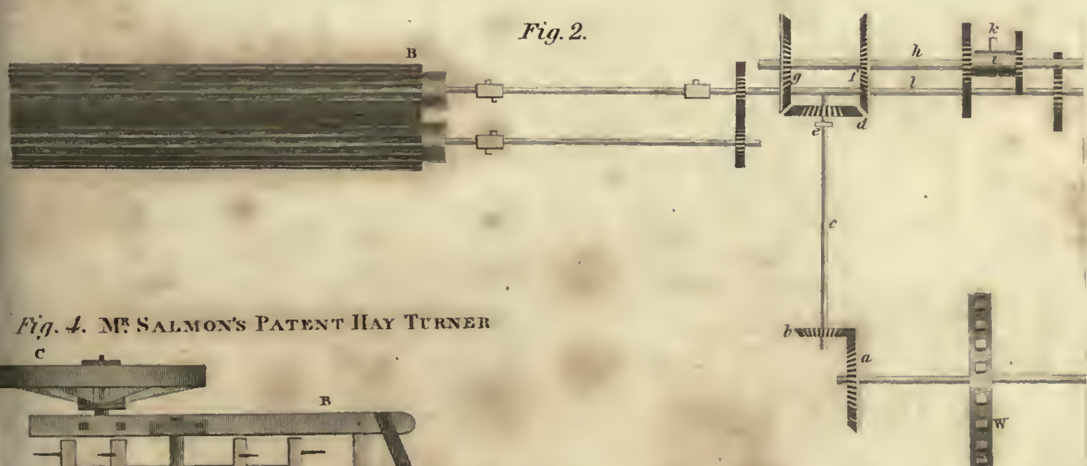


Fig. 4. MR. SALMON'S PATENT HAY TURNER

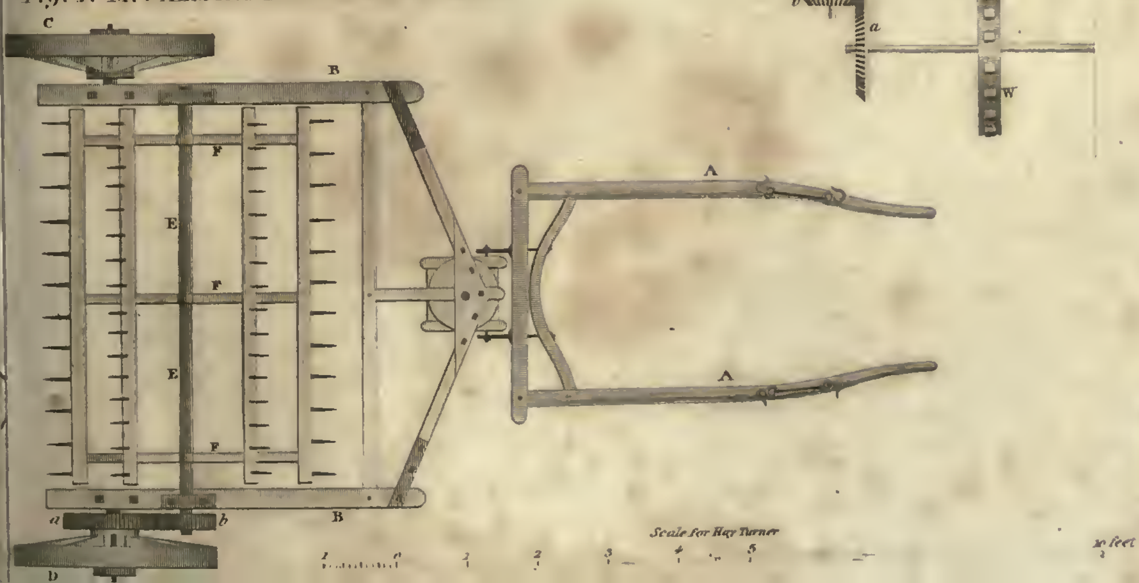
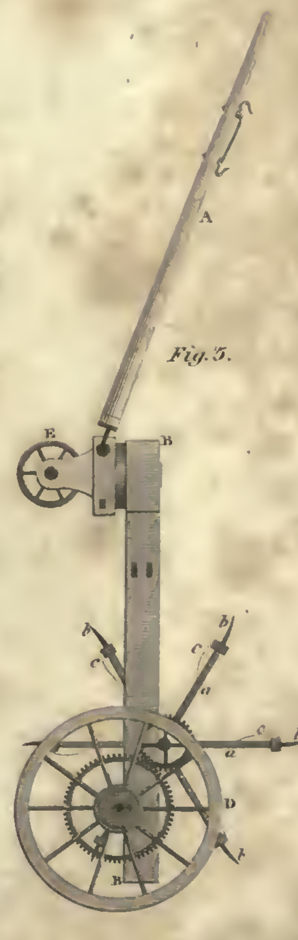


Fig. 5.



Index.

Agrigentum. Agrippa.

AGRIGENTUM, an ancient city of Sicily, the place of which is now partly occupied by the modern Girgenti. It was called Acragas by the Greeks, from its situation on a steep rock. See Girgenti.

AGRIMONIA, a genus of plants belonging to the Dodecandria class, of which the species *eupatoria*, or agrimony, was formerly used in medicine.

Hemp Agrimony, *eupatorium cannabinum*, belongs to the Syngenesia class.

Water Hemp Agrimony, *bidens*, is also arranged under the Syngenesia class of plants.

AGRIPPA, Henry Cornelius, a singular character for the variety of his pursuits and the versatility of his talents, was descended from a noble family, and was born at Cologne in 1486. In early life he entered into the Austrian service, in the capacity of secretary to the emperor; and having distinguished himself in Italy by his military prowess, he received suitable marks of honour from that monarch; but his ambition was not satisfied with military fame, and his literary acquirements enabled him to distinguish himself on a different scene. At this time the fascinating pursuit of the discovery of the philosopher's stone was the chief occupation of many eminent scholars. Agrippa joined in the pursuit, acquired great reputation as an alchemist, and in this character, according to the spirit and fashion of the times, travelled in different countries of Europe. During his stay in England, he was occupied in the study of theology, and when he returned to the continent he read lectures on that subject in his native city. The same course was repeated at Pavia and Turin in Italy; but the unsettled life of the lecturer afforded a very scanty provision for a wife and son, which now composed his family.

The first permanent situation which Agrippa seems to have enjoyed, was the office of advocate and orator of the city of Metz; but he was not destined to remain long in this honourable station. The freedom of his remarks on matters of religion, excited the jealousy and persecution of the monks and clergy, who at last compelled him to resign his situation, and seek shelter elsewhere. His stay at Cologne, to which place he had retired, was short; and assuming a new character, for several years afterwards he practised as a physician in Switzerland and France. While at Lyons, he was fortunate in being appointed physician to Louisa of Savoy, mother of Francis I. with a handsome pension; but his refusal of complying with her request, to predict, according to his astrological knowledge, the success of the arms of her son, was again fatal to his prosperity. Dismissed from her service, and thrown unprovided on the world, he next settled at Antwerp, where the splendour of his talents excited universal admiration, and procured for him various invitations and promises of protection from the most distinguished characters. Accepting of the patronage of Margaret of Austria, governess of the Low Countries, he was appointed historiographer to her brother, the Emperor Charles V., and soon after published the history of his government. But the severe treatment and ill fortune of Agrippa had not yet taught him the lessons of prudence; for, with an unsparing hand, he attacked the errors and prejudices of the times, in a work entitled "*The Vanity of the Sciences*," and roused a powerful host of new enemies. He again lost his patroness and his pension; was thrown into prison for debt; and was no sooner relieved from confinement than he involved himself in a new controversy and persecution, by the publication of a treatise on "*Occult Philosophy*," in which he attempts an exposition of the harmony of the elementary, the intellectual, and celestial worlds. The freedom and violence with which he assailed the errors of the clergy, and the bigotry of the times, which were invariably his favourite themes, provoked the resentment of his enemies, and compelled him to wander for shelter from place to place. While at Lyons, the publication of some satirical compositions against Louisa of Savoy, his former patroness, again deprived him of his liberty. The interposition of friends procured his release; and after a short retirement at Grenoble, death relieved him from all his troubles, in 1535, and in the 49th year of his age.

The life of Agrippa exhibits a remarkable display of varied, of extraordinary talents; and in better times, when alchemy and astrology have vanished before the brighter light of true philosophy, such wonderful powers would have raised their possessor to the very first rank of eminence. But with this brilliant assemblage of intellectual endowments, Agrippa possessed few of the conciliatory virtues. He was rash, imprudent, capricious, and restless; and to a fickle and unsteady temper, not less than to the bigotry and persecuting spirit of the age, are to be ascribed the trouble and disquiet which embittered his days, and pursued him closely through the changing scenes of his eventful career.

Agrippa, Herod, the grandson of Herod the Great, was born about seven years before the birth of Christ; was elevated to the throne of Judea by the emperor Caligula; and in early life was chiefly distinguished by his excessive profusion and extravagance, even among the luxurious Romans. While Herod Agrippa held the sovereignty of Judea, his uncle, Herod Antipas, who had married his sister Herodias, was tetrarch of Galilee, and was ambitious of the name and dignity of king, had repaired to Rome, at the instigation of his wife, to present his request at the imperial throne. Letters from his nephew, Herod Agrippa, charging him with treachery and correspondence with the enemies of Rome, were delivered at the same time to Caligula, who deposed him from his government, sent him into exile, and enlarged the dominions of his nephew, by uniting Galilee with Judea.

Herod Agrippa, to conciliate the favour of the Jews, and to secure his popularity among that people, seems to have encouraged and promoted the persecution of the Christians. James, the brother of John the Evangelist, was put to death, and the apostle Peter suffered imprisonment by the orders of Herod. The close of his life is well known. Arrayed in all the pomp and splendour of eastern magnificence, he received the ambassadors who had come from Tyre and Sidon to sue for peace; and while the words which he uttered were re-echoed by the impious exclamation, "it is the voice of a god, and not of a man," he was seized with a violent distemper, his body was devoured by worms, and, after suffering the most severe agony, he died about the year 44. *Acts*, chap. xii.

Agrippa was the only son of Herod Agrippa, and succeeded his uncle as king of Chalcis, a Roman province. Agrippa is the person mentioned in the Acts of the Apostles, before whom, and his sister Berenice, and Festus governor of Judea, the apostle Paul, who had been imprisoned two years before, and had appealed to the emperor at Rome, defended himself. *Acts*, chap. xxvi.

AGRIPPINA, the daughter of Germanicus, was born at Cologne, in Germany, was greatly admired for her beauty, and so celebrated for her literary acquirements, that Tacitus, the historian, acknowledges himself indebted to her writings; but she was not less remarkable for profligacy, cruelty, and pride. She was three times married; and having persuaded her last husband, the emperor Claudius, who was her own uncle, to adopt her son Nero, she planned the destruction of the former, and at last executed the horrid purpose by poison, to pave the way for the latter to the imperial throne. Nero, her son, who had not failed to profit by the examples of cruelty and profligacy exhibited by his mother, became jealous and impatient of her influence and authority in the government; and having failed in an attempt to have her removed by drowning, issued orders that she should be privately murdered. When the executioner was about to perpetrate the bloody deed, she entreated him to stab her in the belly, which had brought forth so cruel a monster.

AGROSTEMMA, Wild Lychnis, Campion, or Corn-Cockle, a genus of plants belonging to the Decandria class, one species of which is not uncommon in corn fields.

AGROSTIS, Bent-Grass, a genus of plants belonging to the class Triandria. Creeping bent-grass, belonging to this genus, is the celebrated Irish fiorin.

AGUE, the common name of intermittent fevers, or such as have periodical returns of the paroxysm or fit. See Medicine.

AGUILLANEUF, a ceremony which was observed by the ancient Franks, at the commencement of the new year, the origin of which is traced to the Druids, who, with great solemnity, cut off the misletoe of the oak, and, after consecration, distributed it among the people on the first day of the year. The word is composed of *a*, to, *gui*, misletoe, and *l'an neuf*, the new year; practices which seem to have had the same origin, are still prevalent in some parts of France.

AGUR, who is mentioned in the book of Proverbs as the son of Jakeh, is by many supposed to be the same with Solomon, who describes himself under that name; but others think, that Agur and Lemuel, whose name also occurs in the same book, were wise men who flourished in the time of Solomon. Prov. chap. xxx. and xxxi.

AHAB, a king of Israel, who surpassed all his predecessors in acts of impiety and oppression. At the instigation of his wife Jezebel, he established idolatry in his kingdom, for which he was reproved by the prophet Elijah, and a famine of three years in his dominions was predicted. In his time, and at the request of Elijah, the people of Israel, and the prophets of Baal, were assembled to offer sacrifice; and it was proposed by the prophet to ascertain whether Jehovah or Baal were the true god, by calling upon them separately to consume the offering by fire from heaven. At the prayer of Elijah his burnt-offering was consumed, but the idol Baal was invoked in vain. His priests were instantly put to death, and the famine was removed from the land. The oppression and wickedness of Ahab, in which he was aided by the artifice of his wife, were remarkably exemplified, in compassing, by means of false testimony, the death of Naboth, an inhabitant of Jezreel, and seizing his vineyard, to extend the gardens of his palace. For this wickedness, he was threatened by the prophet with the judgments of heaven upon his house. Ahab, during great part of his reign of 22 years, was engaged in war with the Assyrians. He was wounded with an arrow as he conducted his troops to attack Ramoth-Gilead, and died in the evening of the same day, 897 years before Christ. His chariot, which was stained with his blood, was washed at the fish-pool of Samaria, and the prediction of the prophet, that the dogs should lick his blood, was thus fulfilled. 1 Kings, chap. xvii.

AHAZ, who succeeded his father Jotham, was king of Judah, during an unfortunate reign of 16 years. His territories were invaded by the kings of Syria and of Israel, and were constantly exposed to the incursions of surrounding nations. To procure the assistance of the king of Assyria against this overwhelming force, Ahaz exhausted his treasury, and despoiled the temple of its ornaments. He was attached to idolatry; suppressed the worship and sacrifices in the temple, and erected altars to idols in every part of his dominions. 2 Kings, chap. xvi.; 2 Chron. chap. xxviii.

AHAZIAH, king of Israel, was the son of Ahab, and succeeded his father. Like him, he was attached to idolatry; and having dispatched messengers to consult the god of Ekron about his recovery from a dangerous illness, they were met by the prophet Elijah, who assured them that the king should die. Ahaziah, displeased at the intimation, ordered the prophet to be apprehended; but two of his officers, with 50 men each, in attempting to execute his command, were destroyed by fire from heaven. Elijah agreed to accompany another party which was sent to bring him before the king, and again warned him of his end, as the punishment of forsaking the true God; and the prediction of the prophet was verified by the death of Ahaziah, after a short reign of two years, and 895 years before Christ. 2 Kings, chap. i.

AHITOPHEL, the friend and counsellor, and afterwards the violent enemy of David king of Israel. When Absalom rebelled against his father, Ahitophel joined him, and became one of the most active conspirators. The plans which he suggested, and the vigorous measures which he proposed to carry them into execution, seriously threatened the power and authority of David; but other counsels prevailed, and the sagacious Ahitophel perceiving the certain ruin of the rebels, from the inefficiency of their conduct, or disappointed that his advice was rejected, went to his house, and destroyed himself. 2 Sam. chap. xv. and xvi.

AHLEDEN, a district in the principality of Lunenburg Zell, in Germany, is about five miles in length, and abounds with timber, great quantities of which are floated to Bremen for exportation.

AHMEDABAD, or Amedabad, the capital of the province of Guzerat, in Hindostan, received its name from Sultan Ahmed, who was king of the province. The city, which is situated in a fine plain, watered by the river Sabermatty, is more than four miles long, including the suburbs, has 12 gates, and is well fortified. The principal buildings are, the castle, the palace, the caravanseray, and the English factory; and none of the least remarkable are two hospitals, established by the Hindoos, one of which is appropriated for the reception of sick birds, and the other for sick beasts. It was taken by the British in 1780, and restored to the Mahrattas in 1783. E. Long. 72° 37′. N. Lat. 22° 58′.

A-HULL, the situation of a ship when her sails are furled on account of the violence of the storm; her helm is lashed to the lee side, and she lies nearly with her side to the wind and sea.

AHUYS, a small sea-port town of Gothland in Sweden, about 18 miles from Christianstadt.

AJACCIO, or Ajazzo, a sea-port town of Corsica, situated on the north side of a gulf of the same name, which lies on the south-west coast, is the capital of the island, contains more than 6000 inhabitants, and will be long remembered as the birthplace of Bonaparte. Excellent wines are produced in the vicinity; the coral fishery is a considerable source of trade, and the gulf affords good anchorage to ships of large burden.

AJAN, a country of Africa, having Abyssinia on the north, and the Indian ocean on the east, and extending to Cape Guardafui. This country is celebrated for its breed of horses, and in the northern parts it abounds with all kinds of provisions. On some parts of the coast the inhabitants are white, and have long hair.

AJAX, the son of Telamon, was one of the bravest warriors among the Greeks in the Trojan war, and is celebrated by Ovid as the competitor with Ulysses for the armour of Achilles. Disappointed of this prize, he became deprived of his reason, according to one account, but according to another, he destroyed himself.

Ajax, the son of Oileus, prince of the Locrians, was one of the principal Grecian leaders in the siege of Troy, and furnished 40 vessels for that expedition. He was transfixed with a thunderbolt, and his fleet was dispersed by a storm, through the influence of the goddess Minerva, in whose temple he had committed an outrage on Cassandra the daughter of Priam.

AJAZZO. See Ajaccio.

AICHSTADT, a city of Franconia, in Germany, the capital of a bishopric, in whose cathedral is deposited a vessel of gold of extraordinary richness and magnificence. It is called the Sun of the Holy Sacrament, and is said to be decorated with 350 diamonds, 1400 pearls, 250 rubies, and other precious stones. Aichstadt is 37 miles south of Nuremberg.

AILESBURY, or Aylesbury, a small borough town in Buckinghamshire, which consists of about 400 houses, sends two members to parliament, and is 44 miles north-west from London.

AILSA, a remarkable insulated rock, at the entrance of the frith of Clyde, and between the coasts of Cantyre and Ayrshire, in Scotland, is of a conical form, about two miles in circumference at the base, and rises to the height of nearly 1000 feet above the level of the sea; is accessible only by a small bay on one side; and the remains of a fort, vaguely reported to have been erected by Philip II. about the time of the invasion by the Spanish Armada, are still visible on a precipitous cliff. Ailsa is the summer resort of innumerable flocks of sea-fowl, particularly the solan goose and the puffin, which are annually taken in vast numbers on account of their feathers. The banks in the neighbourhood of Ailsa abound with fish.

AINSWORTH, Robert, a learned grammarian, and author of a well known Latin dictionary, was born in 1660 at Woodyale in Lancashire; was educated at Bolton, in the same county, where he taught a school for some time; removed to Bethnal Green, and afterwards to Hackney, where he superintended a seminary for the education of youth; and having acquired a moderate competency, retired from his laborious profession, and devoted his time to antiquarian researches, especially to the collection of old coins. His Dictionary of the Latin language, which was begun in 1714, and occupied 22 years of his life, was first published in quarto, in the year 1736; and enriched with the improvements and additions of succeeding lexicographers, it is now regarded as the completest dictionary of that language. A ridiculous story is in circulation, and is formally announced on pretended good authority, that his wife, disappointed at being deprived of his company, while he was occupied in the composition of the dictionary, committed the whole manuscript, which was brought down to the letter S, to the flames; and that his indefatigable industry and patience soon repaired the loss. Mr Ainsworth died at London, and was buried at Poplar. A monumental inscription in Latin, composed by himself, appears on his tombstone.

AIR, the thin, transparent, compressed fluid which surrounds the globe of the earth. For an account of its properties, see Chemistry, Meteorology, and Pneumatics.

Air, in *Music*, in its strictest acceptation, signifies a composition for a single voice, and applied to words; although the meaning is sometimes extended to any melody the passages of which are so constructed as to be within the limits of vocal expression; or which, when it is sung or played, forms a connected chain of sounds, which is called a *tune*.

Air and Airshire, a town and county in Scotland. See Ayr and Ayrshire.

Aira, Hair-Grass, a genus of plants belonging to the class Triandria.

Air-Balloon. See Aerostation.

Air-Bladder, a peculiar organ in fishes, by the compression and dilatation of which they have the power of rising and sinking in the water.

Air-Gun. See Pneumatics.

Air-Pump. See Pneumatics.

AISNE, one of the northern departments of France, derives its name from the river, which is navigable through the whole department; contains a population of more than 430,000; produces corn, fruits, and cattle, and supplies Paris with wood from its extensive forests. The manufacture of glass is carried on in the forest of St Gobin. Laon is the capital of this department.

AITON, William, an eminent botanist and gardener, was born in 1731, at a small village near Hamilton, in Scotland. In 1754 he went to England, and was employed as an assistant in the physic-garden at Chelsea, under the celebrated Philip Miller; and five years afterwards he was appointed by the Princess-Dowager of Wales to the superintendance of the botanical garden at Kew; a situation which he retained during life. In 1789, he published a catalogue of the plants cultivated in this garden, under the title of *Hortus Kewensis*, in 3 vols. 8vo, containing 13 plates, and an enumeration of between 5000 and 6000 species; with notices of the first introduction of particular exotics into England. Mr Aiton died in 1793.

AJUGA, Bugle, a genus of plants belonging to the Didynamia class, of which three species are natives of Britain.

AIUS Locutus, or Loquens, which signifies *speaking voice*, a deity to whom the Romans erected an altar. A voice was heard by night near the temple of Vesta, informing the Romans of the approach of the Gauls: The warning was neglected; but when the event confirmed its truth, Camillus acknowledged the voice to be that of a new deity, and recommended the altar to be erected.

AIX, an ancient city of France, and capital of the department of the Mouths of the Rhone, formerly Provence, is said to have been the first Roman station in that country, where Caius Sextus Calvinus, the consul, established a colony more than 100 years before the Christian era; and from this consul, and the warm mineral springs of the place, the city derived the name of *Aquæ Sextiæ*. Few remains of antiquity are now visible; the ancient baths were only discovered about the beginning of the eighteenth century. The modern city is distinguished by elegant public buildings, spacious streets and squares, and a fine walk, shaded with trees, and cooled with fountains. In the church of one of the convents in the city, it is said that there is a silver statue of the Virgin Mary nearly the size of life. Aix has some trade in oil. The population exceeds 23,000; it is five leagues distant from Marseilles, and 163 from Paris.

AIX-LA-CHAPELLE, a fine city of Germany, in the circle of Westphalia and duchy of Juliers, is situated in a valley, and surrounded with mountains and woods. Aix-la-chapelle lays claim to considerable antiquity; was a place of note in the time of the Romans, who selected it as one of their stations, and, from its celebrated mineral waters, gave it the name of *urbs aquensis*, city of waters, and *aquægranii*, or waters of Granius; and became the residence of the emperor Charlemagne, who rebuilt and enlarged it after the destructive ravages of the Huns under their leader Attila, in the year 451. A chapel, erected by Charlemagne, and dedicated to the Virgin, was the origin of its present distinctive appellation. The coronation of the king of the Romans was formerly performed in this place, where, it is said, the sword of Charlemagne, the book of the gospels, jewels, &c. employed in that ceremony, are still preserved. The more ancient city, about two miles in circumference, is included in another of later date, and more than double its extent, and both are surrounded with walls and flanked with towers. The city is traversed by many rivulets; some of which drive machinery; and it is adorned and refreshed by twenty public fountains, one of which, distinguished by its elegance, is surmounted by a statue of Charlemagne, of gilt brass. Some of the public edifices are remarkable for their magnificence; among which the cathedral and stadthouse hold the first place. The latter fabric consists of three stories. The uppermost is occupied by one apartment of 160 feet in length and 60 in breadth. The treaties of peace between France and Spain, in 1668, and between France, England, and the allies, in 1748, were arranged and concluded in this city. The population exceeds 23,000.

But the chief celebrity of Aix-la-Chapelle is derived from its mineral waters, which attract strangers from very distant regions. The waters contain sulphuretted hydrogen gas, which, as it escapes, deposits the sulphur, and the latter is sometimes collected and sold, carbonate of lime and soda, and common salt. The temperature varies from 112° to 143° Fahr. The waters are used internally or by bathing; and for the latter purpose numerous and commodious baths are constructed.

AKENSIDE, MARK, a celebrated poet, was born at Newcastle-upon-Tyne, in 1721. His father, a butcher by trade, destined him for the ministry among the presbyterian dissenters, and sent him, at the age of eighteen, to the University of Edinburgh, where he might complete an education that had been rapidly advanced at the free school and a private academy in his native place. The clerical profession not suiting the taste of the young man, those studies, which are commonly directed towards it, were abandoned at the close of his first college session, when he devoted himself with eagerness to the cultivation of general literature, and finally resolved on the medical profession. Having formed this determination, he repaid a certain contribution, allotted by the English dissenters for the instruction of their poorer theological scholars, on which partly he had hitherto been maintained, but to which, considering his altered views, he honourably thought he had now no claim.

The medical school of Edinburgh at this time had not risen to that eminence which it afterwards acquired, though possessed of some important advantages productive of its future greatness. Its rising consequence still acknowledged the superior dignity of the Dutch professors. Our poet, accordingly, after a residence in that University of three years, diligently and variously occupied, repaired to Leyden, where, in 1744, he took his degree in medicine; and at this place he became intimate with Mr Dyson, then a student of civil law, to whose friendship and liberality he was subsequently indebted for very substantial favours. On his return to England, in the same year, he published the poem by which his name is consecrated in the history of our literature. How long this brilliant production, "The Pleasures of Imagination," had employed his genius, does not exactly appear; but there can be little doubt that its basis at least was adjusted previously to his residence in Edinburgh, where he had been noted for poetical talents. The success of this performance was flattering at its first appearance. In the words of Pope, whose advice, according to Dr Johnson's information, had been taken by Dodsley the publisher, as to the reasonableness of the price demanded for it, which was L.120, the author "was no every-day writer." There existed few poems in the language, indeed, a comparison with which Akenside might have scrupled to encounter; and in certain qualities essential to excellence, it is still questionable if he has ever been surpassed. But to this commendation, it is neither invidious nor unnecessary to add, that he himself did not every day write so well. Some smaller pieces of a later growth were not equal to his early promise; and the many alterations which he projected on this work at various times, and by which, had they been fully effected, it must have been subjected to a very different character, are more remarkable for a solicitude to justify public opinion, than calculated to command it by irresistible flashes of genius. The faculty of invention, in which, perhaps, he was originally defective, could not emerge from the process of correction. The mind of Akenside was so disciplined to thought, and furnished with all the ordinary helps which ensure accuracy, that it might have safely trusted itself in the loftiest flights of fancy, totally regardless of those restraints which are too often imposed by the caprices of criticism; and perhaps it needed such indulgence to divest itself of a stiff, though dignified deportment, which seems to have been induced by warm admiration of antiquity, and excessive attachment to classical learning.

The circumstances of the private life of Akenside, it may be suspected, contributed not a little to check the efforts of his muse in attempting higher degrees of poetic excellence. He was mortified in an unequal struggle with Dr Stonehouse, who had successfully preceded him in medical practice at Northampton; and having left that place, first for Hampstead, and then for the capital, where he had still more formidable difficulties to encounter, he was saved the necessity of exertion, which so frequently proves the source of eminence, by the offer of L.300 a-year from his friend Dyson, till his profession afforded him an adequate income. A bounty so unusual was perhaps more creditable to the giver than salutary to the receiver, as it probably proved obstructive of his muse's compassionating inspirations.

The fame of Akenside as a poet, which had been his precursor in London, the well-founded confidence of his friends in the superiority of his talents, and the extent of his acquirements, added to a prudential use of all the common modes of attracting notice, procured him distinction, though some peculiarities of manner, and an accommodating temper of mind, were wanting to obtain popularity as a physician among numerous candidates. At last, however, he made some progress in professional employment and reputation; he became physician to St Thomas' Hospital; and among the honours at which he successively arrived, was his appointment of physician to the queen. This took place a little before his death, which was occasioned by a putrid fever, in June 1770, and in the 49th year of his age.

Akenside's poetical works, viz. "The Pleasures of Imagination," as last modelled by himself, and two books of odes on various occasions, were published by Mr Dyson, who survived him, in 1772.

His Treatises on subjects belonging to medical science, which he seems to have conscientiously prosecuted, are mostly all inserted in the Philosophical Transactions. Our opinion of Akenside's genius as a poet has been partly stated. "The Pleasures of Imagination," the only production by which his name can be preserved from oblivion, must be judged by a peculiar standard. It is a didactic poem, on a subject which, besides being of difficult discussion, had descended to him previously entangled in opinions rendered venerable by their antiquity, and become still more enticing by the refining artifices of modern philosophy.

The chief excellencies of Akenside are, ardent devotion to what is truly good, strength of conception, richness of imagery, and a noble command of elegancies in language and sentiment; his chief faults are more to be regretted than condemned; want of originality, narrowness of invention, and a kind of perplexed exuberance of ideas, which, unless the reader is perfectly familiar with the exercise it occasions, is apt utterly to distract attention from the main object that is thought entitled to such extraordinary accompaniments. "In the general fabrication of his lines," says Dr Johnson, "he is perhaps superior to any other writer of blank verse; his flow is smooth, and his pauses are musical; but the concatenation of his verses is commonly too long continued, and the full close does not recur with sufficient frequency. The sense is carried on through a long intertexture of complicated clauses, and as nothing is distinguished nothing is remembered."

AL, an Arabic particle, signifying *the*, which is prefixed to words, as Al Kali, Alkoran, the Kali, the Koran.

ALABASTER, a common name which has been long applied to some varieties of gypsum, or plaster of Paris, which are employed for the purposes of statuary and ornamental productions, as vases and small figures for the interior of apartments. It is also applied to some kinds of marble or carbonate of lime. See MINERALOGY.

ALAMAGAN, one of the Ladrone islands in the Indian ocean, is about 12 miles in circumference; the land is in some places so elevated, that it is seen at the distance of 12 or 14 leagues; and a volcanic mountain, close to the sea, rises to the height of 1200 or 1500 feet.

ALAND, with its dependent islands, about 80 in number, is situated between the gulfs of Bothnia and Finland, in the Baltic. These islands lie between N. Lat. 59° 47′ and 60° 30′, and between E. Long. 19° 17′ and 22° 7′. Aland, the principal island, is about 20 miles long, and 16 broad. The inhabitants of this island, the number of which, in 1772, exceeded 19,000, are employed in agriculture, in fishing, or the ordinary mechanic arts. Wheat, rye, oats, and barley, are sufficiently productive in some parts of the island; the climate is in general favourable, and the sea around the island is seldom frozen. The inhabitants of Aland resemble the peasants of Sweden in their dress, manners, and customs. The mountains are chiefly composed of red granite; the quadrupeds and birds are such as are common to northern regions, and fish are abundant.

ALANS, a warlike and barbarous people, supposed to be of Tartar origin, who seem to have first occupied the mountainous region near the source of the river Jaick. Migrating southwards, they settled on the Danube, in the year 406; traversed Gaul, and afterwards entered Spain, and seized many of its finest provinces. Discomfited and dispersed by the Goths and Franks, their name was finally blended and lost in that of their conquerors. The Alans resembled the Tartars by travelling in waggons; in regarding their flocks as their riches; in adorning the trappings of their horses with the scalps of their enemies; in their attachment to warlike exercises; and in considering the warrior peculiarly fortunate who died in the field.

ALARIC I. a celebrated Gothic leader, and king of the Visigoths, was first distinguished when he passed the Danube, in the year 376, with an army of 200,000 men. According to the policy of the Roman emperors, who engaged one tribe of barbarians to protect the provinces against the inroads of others, Alaric appeared in a conspicuous and efficient character in the Gothic war which ended in 382; but thinking himself overlooked, and his services neglected, he collected his army, and laid waste the finest provinces of Greece. Even the city of Athens was only spared in consequence of the earnest intreaties and humble submission of the inhabitants. Advancing into Peloponnesus, his career of cruelty and blood received a slight check; but having amused and deceived the rival emperors by his cunning and treachery, he invaded Italy in the year 400, and ravaged it without opposition. Alaric suffered another check from a successful attack of the Romans, who overthrew his army with great slaughter. In his second invasion of Italy he appeared before the walls of Rome, and having received large sums of money, raised the siege; but his army being reinforced, he again invested the capital, took it by assault, deposed the emperor, and gave up the city to the plunder of his soldiers, which was continued for six days with the most ferocious cruelty, and with no regard to rank, age, or sex. This happened in the year 410. Alaric died the following year, while his troops were preparing to embark for Sicily; and it is not a little singular, that the place of his burial was the channel of a river, the waters of which were for a time turned from their course, to allow the body to be deposited in the grave.

ALARIC II. a king of the Visigoths, succeeded his father Euric in the year 484, and possessed the sovereignty of the whole intermediate country between the rivers Rhone and Garonne. The name of Alaric has been transmitted to posterity in consequence of his attempt to adapt the laws of the emperor Theodosius to the genius and character of his own people. These institutes are known by the title of the Code of Alaric; the Arian controversy keenly prevailed in the time of his reign, and he not only espoused the heresy, but supported its tenets by the power of the sword. Clovis, the king of the Franks, advanced with an army against him, and routed the Goths. The two kings agreed to meet in single combat, and Alaric fell in the encounter, which took place in the year 507.

ALAUDA, the lark, a genus of birds belonging to the order of Passeres. See ORNITHOLOGY.

ALAY, which signifies triumph, is a singular ceremony observed by the Turks at the commencement of war. The alay begins with a procession, in which artizans, seated in splendid cars, exhibit to the spectators the implements of their trades, and the mode of operation. The standard of the prophet, which is conveyed from the seraglio, and is to be presented to the army, next follows, and is beheld with the most fanatical enthusiasm. The Emirs only are permitted to touch it, and the look of an infidel is regarded as the most dreadful profanation. On one occasion, described by Baron Tott, the Emir who preceded the consecrated banner, exclaimed with a loud voice: "Let no infidel profane with his presence the standard of the prophet, and let every mussulman who discovers an unbeliever make it known, under pain of reprobation." The Christians, ignorant or unsuspicious of danger, had crowded to witness the ceremony, and were in a moment involved in one undistinguished massacre.

ALBA, or Alba Fucensis, from its vicinity to the Fucine lake, now called Albi, is an ancient town of Italy, and is noted in Roman history as the state prison, where captive princes, after being exhibited in a public triumph, were confined. It is situated in a mountainous region, and the remains of a fortification, as well as the ruins of an amphitheatre, a temple, and some other public buildings, are still visible.

ALBA is also the ancient name of several Roman towns, as Alba Helviorum, now Viviers in Languedoc, in France; Alba Julia, now Weissenburg, in Transylvania; and Alba Longa, in Italy, which was established by Ascanius, the son of Æneas, at the foot of the Albanian mount, was the royal residence till the building of Rome, and was destroyed by Tullus Hostilius, and the inhabitants were removed to Rome.

ALBAN, ST. reputed the first Christian martyr in Britain, was born at Verulam, and flourished about the end of the third century; visited Rome in company with Amphibalus, a monk of Caerleon, and served as a soldier for seven years in the army of Dioclesian; after his return to his native country was converted to Christianity, through the influence and instructions of the monk who had been his friend and companion; and suffered martyrdom about the year 303, during the persecutions which raged under the reign of that emperor. Numerous miracles, it is said, accompanied his execution. St Alban was held in such veneration, that, more than four centuries after his death, Offa, king of the Mercians, erected a magnificent monastery to his memory. About the middle of the 13th century, when the church was repaired, some leaden chests, containing relics, were discovered, one of which was supposed to be the depository of the body of the martyr. The town of St Albans derives its name from this saint.

ALBANI, or ALBANO, FRANCIS, an eminent painter, was born at Bologna in Italy, in 1578. He discovered an attachment to painting at the early age of 12, and studied, first under Denys Calvert, and afterwards in the school of the Caracci, along with the celebrated Guido Rheni, with whom he contracted a very intimate friendship; but a rivalship for fame in the same profession soon dissolved the connection. Albani afterwards resided many years at Rome; and on the death of his first wife returned to his native city, where he married a beautiful and handsome young lady, who, with her children, served as the models of his Venuses and cupids, and, it is supposed, contributed to give that sameness of form and attitude which is observed in his figures. The reputation of Albani procured him general respect while he lived; he received the visits of the most distinguished persons in his own profession; enjoyed the correspondence of several princes; and was invited to England by Charles I. in a letter signed with his own hand. His paintings are admired for elegance of design and harmony of colouring. His most celebrated picture is that of the four elements, in the palace of Turin; and his smaller pictures grace the cabinets of most collectors. Albani died in 1660, at the advanced age of 82. The following is a translation of some epigrammatic verses which were intended for his monumental inscription, and are still preserved:

"The mortal remains of the illustrious Albani, who gave life to shade, lie interred in this tomb; the earth never produced so wonderful an artist, or a hand like his, which gave colours to the soul, and a soul to colours. Prometheus animated clay, and gave life by means of the sun; but Albani animated merely by the assistance of shade."

ALBANIA, an ancient kingdom of Asia, which lies chiefly between the Euxine and Caspian seas, and is bounded on the north by mount Caucasus. It is now known by the names of Schirwan and East Georgia. Albania was formerly an independent kingdom, and it is doubtful whether it was ever under complete subjection to the Roman power. Many parts of the country are extremely fertile. The men of Albania are celebrated by ancient historians for their comeliness, stature, and strength; and the beauty of the women is highly extolled by modern travellers.

ALBANIA, the ancient Epirus, is an extensive province of the Turkish empire, which lies between the 39th and 43d degrees of north latitude, stretching about 250 miles along the coast of the Mediterranean and the Gulf of Venice. The greatest breadth inland is not more than 100 miles, and towards the south it does not exceed 30 miles. The mountainous chain of the ancient Pindus separates this country from Macedonia and Thessaly.

The Albanians first rose to distinction on the decline of the Greek empire; by their valour they resisted the Bulgarians, who had become masters of the contiguous provinces of Greece; and, under the command of the celebrated leader George Castriot, better known by the name of Scanderbeg, they successfully opposed Mahomet II. the conqueror of Constantinople, who employed the most vigorous efforts in their subjugation; but, after all his exertions, he was compelled formally to acknowledge their independence. The death of their leader, and the renewed attacks of the Turks, forced them, in 1478, to submit to a state of nominal subjection, which seems never to have been general or cordial.

Revolts were not uncommon in many parts of the province; the inhabitants of the mountainous regions never gave up their independence; and now, by the energy and vigorous enterprize of Ali Pasha, its present governor, Albania almost holds the rank of a separate kingdom. Since the year 1811, when he gained possession of some of the most fertile parts of the country, and added to his government a population of nearly 300,000 souls, his power is almost absolute. Such, indeed, is his political influence, that, it is said, Bonaparte solicited his favour, and, with his usual liberality, offered to raise him to the dignity of king of Albania; but the Pasha had the sagacity to perceive the ambitious designs of the French ruler, and considered it a wiser policy to attach himself to Britain. This bold chief keeps up an army of 10,000 men; his revenue, of which a small part only is supposed to be remitted to Constantinople, is considerable, and his annual income from private property is estimated at L.200,000 Sterling. An immense building near Joannina, the capital of the country, which may be considered as a kind of fortified palace, is the usual residence of Ali. His haram, in which are immured 300 females, is a distinct edifice, and fitted up in a most magnificent style.

The inhabitants of this country are estimated at 1,200,000; they are of a gay, lively, and active character; averse to regular industry, strongly attached to arms and plunder, and think it no disgrace to join the numerous bands of robbers who infest the mountainous districts. They are not very rigid followers of the prophet; and indeed the true believers regard them as infidels. The women are held in a greater degree of contempt than is usual even among the most barbarous nations. The Turkish cavalry, known by the name of *Arnauts*, are raised in Albania.

Joannina, the capital of Albania, finely situated on the banks of a lake, is very irregularly built; but as it is interspersed with trees and gardens, and surrounded with lofty mountains, it presents a picturesque appearance. The inhabitants are estimated at 35,000. Among the Greek residents science and literature are not neglected; and the commerce of Albania is in the hands of the same people, who conduct it through Arta, a town in the southern district of the country, and situated on a gulf of the same name. Among the exports are enumerated, timber for building, and fire-wood to Malta; grain to the same place; to Italy, and the Ionian isles, wool and some coarse cloth, cotton and cotton yarn, oil and tobacco. Guns, gunpowder, hardware, coffee and sugar, are included in the list of imports. A very active commercial scene is annually exhibited in October, at a fair held in the vicinity of the capital. See Hobhouse's *Travels in Albania*, and Holland's *Travels in the Ionian Isles and Albania*.

ALBANO, a town of Italy in the Campagna di Roma, and on the banks of a lake from which the name is derived. Ancient monuments, some of which are reputed, on doubtful authority, to be the tombs of Ascanius, the son of Æneas, and of the celebrated Horatii and Curiatii, are seen at the entrance of the town; and the ruins of Domitian's palace in the vicinity are also visible. The lake, which is seven miles in circumference, and embosomed in an amphitheatre of lofty mountains, the Barberini palace, with its fine gardens, and the salubrious climate, render Albano an attractive spot, and an agreeable summer retirement to the Roman nobility. It is 15 miles south-east from Rome.

ALBANS, St. a borough and market-town of Hertfordshire in England, near the spot where the ancient Roman city Verulam stood, the place of which is marked only by the remains of some mud walls and the occasional discovery of Roman coins and fragments of pottery. The monastery was erected in the end of the 8th century, by Offa, king of the Mercians, to the memory of St Alban. The church still remains, and contains the tombs of the founder, and of Humphrey, Duke of Gloucester. The body of the latter, in a leaden coffin, and pretty entire, was discovered in a vault about the beginning of the 18th century. A monument to the memory of the great reformer of philosophy, Lord Bacon, is erected in St Michael's church. St Albans is a great wheat market. The population exceeds 4000, and it is 21 miles distant from London.

ALBANY, the capital of a county of the same name in the state of New York in North America, situated near the head of Hudson's river, and in the midst of a fertile country, traversed with numerous navigable lakes and rivers, and affording every kind of facility to commercial intercourse. The manufacture of starch, mustard, hair-powder, snuff, and tobacco, is conducted on a large scale at works in the neighbourhood, which are chiefly moved by water. The inhabitants, collected from all parts of the world, were estimated, in 1797, at more than 6000. Albany is 160 miles distant from New York, and 340 south from Quebec.

ALBERONI, Julius, a distinguished statesman, was the son of a gardener at Placentia, where he was born in 1664, continued for some time in the same occupation, and rose to the rank of first minister of state in Spain. For some good offices which he had rendered to the Duke of Vendome's secretary, who had been robbed near the place where Alberoni resided, he was taken into the service of that famous general, accompanied him into Spain, where his powerful talents and bold ambition found ample scope; and having projected and accomplished the marriage of Philip V. and the Princess of Parma, through the interest of that princess he was advanced to the dignity of cardinal and archbishop of Valencia, and finally promoted to the head of affairs in the kingdom. Having effected certain internal arrangements which gave vigour and stability to the government, and having improved and strengthened the Spanish navy, Alberoni directed his ambitious views to the execution of bolder and more daring enterprises. The restoration of the pretender to the throne of England, the annihilation of the power of the Germans in Italy, and of the Duke of Orleans as regent in France, were among his favourite schemes; and to insure their successful accomplishment, he formed a strong alliance with Peter the Great of Russia, Charles XII. of Sweden, and the Ottoman Porte. France and England coalesced against this powerful combination; war was declared in 1719, and the preliminary to the negotiations for peace in the following year was the banishment of Alberoni. He retired from Spain loaded with wealth, spent the last years of his life in establishing a seminary in his native city for the education of the poor, and died in 1752, at the advanced age of 88.

ALBERT THE GREAT, in Latin ALBERTUS BOLSTADIUS, and sirnamed Grotus, or Magnus, a celebrated alchemist, was born at Lawingen in Swabia, about the end of the 12th, or beginning of the 13th century; was educated at Pavia and Paris, and became doctor of medicine; joined the order of Dominican friars, acquired great popularity as a teacher of theology and preacher of the crusades, and was promoted to the bishopric of Ratisbon, the dignity and emoluments of which he resigned, and returned to his cell at Cologne, where he first taught philosophy and divinity, and where he died in 1280.

The superior knowledge of Albert, which travelled far beyond the times in which he lived, drew down upon him the charge of being a magician and a conjurer. His "Book on Minerals," marks his proficiency in natural history; his "*Lilium floris de spinis avulsum*," "Lily of the flower plucked from the prickles," and "*Speculum alchemiæ de compositione lapidis*," "Mirror of alchemy concerning the composition of the stone," shew how deeply he was engaged in the pursuits of alchemy; and the collection of his works, chiefly philosophical and theological, printed in 1651, in 21 folio volumes, affords ample proof of the amazing extent of his industry.

ALBI, a town of Italy. See ALBA.

ALBI, a town of the department of Tarn in France, situated on an elevated bank of the river, is remarkable for the fine choir of the cathedral, a rich silver shrine of exquisite workmanship, in which are deposited the relics of St Clair, the first bishop, and a magnificent chapel dedicated to the same saint. Albi is celebrated for its fine shady walks, and for the richness and beauty of the surrounding scenery. The population is nearly 7000. The distance north-east from Toulouse is 35 miles, and 250 south from Paris.

ALBINO, a name which seems to have been first employed by the Portuguese to designate a variety of the negro race, in which a remarkable deviation in the colour and appearance of the skin, the hair, and the eyes, is observed. The peculiarities of this variety consist in the whiteness of the skin and hair, the redness of the eye, and great sensibility to light. The Albinos, or white Moors, as they have been called, are not confined to the natives of Africa. They have occasionally appeared both among Indians and Europeans; and in some parts of Africa and America, it is said, they are so numerous, that they are considered as a distinct race. Saussure, in his Travels on the Alps, particularly describes two Albinos, brothers, who were natives of the valley of Chamouni.

The researches of anatomists have discovered the immediate cause of the singular appearances in the Albino. The dead white colour of the skin is ascribed to the absence of the *rete mucosum*, or cellular membrane, to which the peculiar colour of the skin and hair is owing. In the negro this membrane is black, and therefore the complexion is the same. The pink or rose colour of the eye in the Albino, is traced to a similar defect, in the want of the black membrane, *pigmentum nigrum* of anatomists, on which the dark colour of the eye depends. A similar redness of the eye, which no doubt arises from the same cause, is observed in white varieties of some quadrupeds, as mice and rabbits. Albinos are generally observed also to have a relaxed and debilitated constitution, and to be deficient in strength and vigour; so that the appearances which they exhibit, and deviations from the ordinary structure of the species, are justly regarded as constituting a peculiar morbid condition of the body.

ALBINUS, BERNARD SIEGFRED, a celebrated anatomist, was born at Frankfort on the Oder, in the year 1697. His father was then professor of medicine in the university of Frankfort; but five years afterwards, being appointed to the professorship of anatomy and surgery at Leyden, he removed to that place, where the son had the best opportunities of improving himself in general literature, as well as in anatomy and surgery, to which he had now particularly devoted his studies, aided and encouraged by the celebrated anatomist Ruysch, and the no less famous lithotomist Rau, who then flourished at Leyden. After a year spent in Paris, Albinus was recalled, and at the recommendation of Boerhaave was appointed lecturer on anatomy and surgery, and on the death of his father, in 1721, professor of anatomy in the university of Leyden.

Albinus soon distinguished himself as an able and useful teacher, and continued to prosecute his favourite studies with great zeal and industry; but his labours were not confined to oral instruction. In 1734 he published *Historia Musculorum Hominis*, the History of the Human Muscles, one of the most splendid and accurate anatomical works which has yet appeared. In 1745, he was appointed professor of medicine in the same university, and was succeeded by his brother in the anatomical chair. With the same unabated zeal, and the same unwearied assiduity, he continued to discharge the duties of his office till the time of his death, which happened in September 1770. Beside the work already mentioned, Albinus was the author of many other valuable productions, connected with the illustration of anatomy and physiology.

ALBION, the ancient name of Britain. The origin of the name is not distinctly ascertained.

ALBION, NEW, a country on the north-west coast of America, which received the name from Sir Francis Drake, who discovered and took possession of it in 1578. This country, which is also called California, was visited by Captain Cook, La Perouse, and more lately by Captain Vancouver, who fixes the boundaries of New Albion between the 30th and 45th degree of N. latitude.

ALBIS, the ancient name of the Elbe, a river in Germany, was long the boundary of the Roman territory in this quarter of the world. Six years before the Christian era, a Roman general having crossed the river with a few troops, was deemed worthy of the honours of a triumph for that exploit.

ALBOURG, a town of Denmark. See AALBOURG.

ALBUCA, Bastard Star of Bethlehem, a genus of plants belonging to the Hexandria class.

ALBUGO, or LEUCOMA, a disease of the eye, or a white opaque spot growing upon the cornea.

ALBUM, a white table or register, in which the names of magistrates and public transactions were recorded. Of these registers there were various kinds, which were distinguished by different names among the Romans.

ALBUMEN, a substance which forms a constituent part, both of animal and vegetable matters, and exists in great abundance in the white of eggs.

ALBUQUERQUE, a town of Estremadura in Spain, is situated on an eminence, and has a considerable trade in wool and woollen manufactures. It is nine miles distant from the frontiers of Portugal, and 20 miles N. from Badajos.

ALBURNUM, a soft white substance, which lies between the inner bark andt he wood of trees, and, acquiring solidity, is converted into the wood itself.

ALCA, or AUK, a genus of birds belonging to the order of Anseres. See ORNITHOLOGY.

ALCÆUS, a celebrated Greek lyric poet, was born at Mitylene, in the island of Lesbos, and flourished about 600 years before the Christian era. He was cotemporary with the poetess Sappho. A very few fragments of his works now remain. His name and reputation have been transmitted to posterity in the works of others, and chiefly by the verses of Horace.

ALCAICS, the name of several kinds of verse, derived from Alcæus, the supposed inventor. One kind, composed of five feet, consists of a spondee, or iambus, an iambus, a long syllable, and two dactyls: another kind consists of two dactyls, and two trochees. These are called dactylic alcaics. The simple alcaic verse consists of an epitrite, two choriambuses, and a bacchius.

The alcaic ode consists of several strophes of four verses each; the first two verses were dactylic alcaics of the first kind; the third verse includes four iambic feet, with a long syllable; and the fourth is a dactylic alcaic of the second kind.

ALCAID, ALCADE, or ALCALDE, an officer of justice or magistrate among the Moors, Spaniards, and Portuguese. The duties of the alcaid in Spain correspond nearly with those of a justice of the peace in Britain; and, among the Moors, the same magistrate is invested with supreme authority, both in civil and criminal matters.

ALCALA DE HENARES, the ancient Complutium, is a beautiful city in New Castile, in Spain; is situated on the river Henares, and is celebrated for its university, which was founded in the 13th century, and restored and more richly endowed by Cardinal Ximenes in the 15th century. The library of the university formerly possessed many valuable manuscripts, which were collected at great expence; and from these manuscripts, and under the superintendance of the most learned men of the time, the celebrated Polyglot Bible, called from the place the Complutensian Polyglot, was printed by Cardinal Ximenes, in 1499. About the middle of the 18th century, many of these manuscripts, it is to be regretted, were disposed of by an ignorant librarian, as waste paper, to make room for new books. Alcala is twelve miles E. from Madrid, to which place the waters of a very pure spring are conveyed for the use of the royal family.

ALCANTARA, a town of Estremadura, in Spain, is situated on the banks of the Tagus, and is celebrated for its fine bridge, which was built in the time of the emperor Trajan. This bridge consists of six arches, is 670 feet in length, 28 in breadth, and rises 200 feet above the surface of the river. The accommodation of the bridge induced the Moors to select that spot for the city, from which the name Al Cantara, or *the Bridge*, is derived. It is 45 leagues from Madrid.

An ancient military order in Spain, denominated the Knights of Alcantara, took their name from this place. They were formerly called Knights of Calatrava, and seem to have been associated for the purpose of expelling the Moors.

ALCARES, a town of La Mancha in Spain, which is celebrated for an ancient aqueduct, and a breed of horses, which are remarkable for their fleetness and strength. It is 138 miles south-east from Madrid.

ALCARRAZAS, a kind of pottery ware, which is manufactured at Anduxar, in Andalusia, in Spain, and are employed for cooling liquids. These vessels are very porous, and as the liquid exudes through their substance, it evaporates rapidly from their external surface, and thus cools down the contained liquid far below the temperature of the atmosphere. Vessels of this kind are in common use in Spain, and are very generally employed in the warmer regions of the globe.

ALCEA, the Holly-hock, a genus of plants belonging to the class Monadelphia.

ALCEDO, the King-fisher, a genus of birds belonging to the order of Picæ. See ORNITHOLOGY.

ALCHEMILLA, Ladies Mantle, a genus of plants belonging to the class Tetrandria, and of which two species are natives of Britain.

ALCHEMY, or the CHEMISTRY, an art, or science, as some call it, which began to be studied about the third or fourth century, and continued to flourish for many ages. The captivating objects which alchemy held out to its disciples and followers were the philosopher's stone, by which the baser metals might be converted into gold, the universal medicine which should cure all diseases, and the universal solvent. Alchemy excited the notice of the Roman government in the time of the emperor Dioclesian, and the books which treated of the subject were ordered to be burnt. In England, it is curious to observe, the practice of alchemy was at one time, about the middle of the 15th century, permitted by licence, while, at other times, it was suppressed by severe edicts. See CHEMISTRY.

ALCIBIADES, a celebrated Athenian general, was not more distinguished by his talents in the field than by his eloquence in the Forum, by the versatility of his private character, than by the instability of his patriotism; now addicted to study and temperance, and now indulging in luxury and dissipation; now fighting the battles of the republic, and now leading the armies of its enemies against his country. His influence among the Athenians excited the jealousy of some of his fellow citizens; he was accused of sacrilege, and recalled from an expedition against Syracuse, to answer to the charge; but he declined the summons, and retired to Thebes; the sentence of condemnation was pronounced against him, and his property was confiscated. He joined the Lacedemonians, and led them to victory against his countrymen. The Lacedæmonians, in their turn, became jealous of his power; and, fearing his return to Athens, threatened his life. To escape the danger he fled, and, through the intercession of two Athenian generals, was restored to the favour of his countrymen, and again admitted to the command of their armies. He soon obliged the Lacedæmonians to sue for peace, and returning in triumph to Athens, was welcomed as a deliverer, recovered his possessions, and was loaded with honours. But such is the fickleness of popular applause, or the watchful jealousy which attended his steps, that the occurrence of a slight disaster again undermined his influence, and deprived him of his command. He retired into exile, and, with a small body of men, made incursions into Thrace; but dreading the vengeance of the Lacedæmonians, he deemed it prudent for his safety to take refuge with Pharnabazus, whose favour he soon obtained, and who bestowed upon him a possession in Phrygia. Endeavouring to secure the friendship and alliance of the Persian monarch on the side of the Athenians, he was basely attacked by a party of assassins, dispatched by Pharnabazus at the instigation of the Lacedæmonians. The assassins set fire to his house in the night, and slew him with arrows as he attempted to escape from the flames.

ALCINOUS, king of Phæacia, now the island of Corfu, is celebrated by Homer for his kindness and hospitality to Ulysses, who was shipwrecked on his coast, and is alluded to by poets on account of the magnificence of his gardens.

ALCMAER, the capital of North Holland, is situated on the banks of a drained marsh, between the North and Zuyder seas; is reckoned one of the handsomest and cleanest cities in the United Provinces; and remarkable for the regularity of the streets, the neatness of the houses, and the magnificence of the public buildings. The drained marsh land around the city is now converted into highly cultivated gardens, orchards, and rich meadows, which last afford abundance of the best butter and cheese in Holland. Alcmaer resisted the force of the Spanish arms during a siege of three months, in 1573. It was taken in 1799 by the British. Alcmaer is celebrated for the culture of flowers. The account of a remarkable sale of tulips, which took place in 1637, is still preserved in the records of the city, in which it is stated, that 120 roots with their offsets brought more than L.8000 Sterling. A single root, the Admiral of Enckhuysen, was sold for more than L.460 Sterling. Alcmaer is 24 miles distant N. W. from Amsterdam.

ALCOBACA, a town of Estremadura in Portugal, situated on the small river Alcoa. and chiefly remarkable for a rich monastery, which is the burial-place of the Portuguese royal family, and the manufacture of cambrics and woollens.

ALCOHOL, or ALKOHOL, rectified spirit of wine. See CHEMISTRY.

ALCORAN, or ALKORAN, the Scripture or Bible of the Mahometans. See KORAN.

ALCUIN, or ALCUINUS FLACCUS, an eminent English writer, who flourished about the end of the eighth century; was abbot of Canterbury; and being sent by the king of Mercia on an embassy to the emperor Charlemagne, he was invited to enter into the service of that monarch, and became his preceptor in the learning of the times. The rapid progress of letters during the splendid reign of Charlemagne, and the establishment and endowment of the universities of Paris, Tours, Soissons, and others, are ascribed to the influence and prudent exertions of Alcuin. Retiring in 801 from the active scenes of life to his abbey of St Martin's at Tours, he spent the remainder of his days in superintending a seminary of education which he had founded, and in acts of piety and devotion, and he died in 804. The works of Alcuin, published in a folio volume at Paris, in 1617, consist of tracts upon the Scriptures, morality, and history, of letters, and poems.

ALDERMAN, is a title to which various degrees of rank and authority have been attached in the progress of English history. Among the Saxons, it denoted a degree of nobility corresponding with earl or count, and afterwards was applied to a person who performed the duty of a judge. Alderman, in the present day, is a subordinate magistrate to the mayor of a city; and the number of these magistrates is regulated by the extent and population of the place. In London there are 26 aldermen, to each of whom a ward of the city is committed. The office is continued for life; and on the death or resignation of an alderman, a wardmote or meeting of the ward is held for the election of a successor to supply the vacancy.

ALDERNEY, an island on the coast of France, subject to Britain, is separated from Cape la Hogue, in Normandy, by a narrow strait, called the *Race of Alderney*, which is a dangerous passage in stormy weather; is eight miles in circumference; the soil is fertile and well cultivated, and it is remarkable for a fine breed of cows. The inhabitants, estimated at 1000, occupy a small town in the centre of the island. The Victory, of 110 guns, a British man-of-war, perished, in 1744, with her whole crew of 1100 persons, on the rocks in the neighbourhood of Alderney. N. Lat. 49°. 45′. W. Long. 2°. 7′.

ALDRED, archbishop of York, who flourished in the 11th century, rose from a humble station to that high ecclesiastical dignity; was in great favour with Edward the Confessor, and performed the ceremony of coronation to his successor, Harold, and to William the Conqueror. A remarkable instance of William's servility, and of Aldred's haughtiness, is recorded. One of the king's governors having offended the archbishop, he repaired to London with a train of ecclesiastics, rushed into the presence of the monarch, and threatened him with all the vengeance of the church. The king, terrified, threw himself at the feet of Aldred; and when the nobility expressed their indignation at the insolence of the prelate, he calmly replied, " Good men, let him lie there; he is not at Aldred's, but at St Peter's feet: he must feel St Peter's power, since he dared to injure his vicegerent." Aldred died in 1066.

ALDRICH, Henry, an English divine, who was born at Westminster in 1647; received his classical education under the celebrated Dr Busby; studied at Oxford; and was promoted, in 1689, by King William, to the deanery of Christ Church. In the controversial discussions concerning popery, in which he had engaged in the preceding reign, Bishop Burnet eulogises him as having treated the subject with a "solidity of judgment, clearness of argument, depth of learning, and vivacity of writing, far beyond any that had before that time appeared in our language." Dr Aldrich is better known on account of his attachment to music and the lighter species of poetry. Various services for the church, and a number of anthems, are acknowledged to be of his composition; two of his Latin poems are preserved in the *Musæ Anglicanæ;* he is the author of the popular catch, "Hark, the bonny Christ-Church bells;" and the following epigrammatic verses, entitled, "*Causæ bibendi,*"—"Reasons for drinking," are ascribed to him.

Si bene quid memini, causæ sunt quinque bibendi;
Hospitis adventus, præsens sitis atque futura,
Aut vini bonitas, aut quælibet altera causa.

If on my theme I rightly think,
There are five reasons why men drink—
Good wine, a friend, because I'm dry,
Or lest I should be by and bye,
Or any other reason why.

Dr Aldrich died in 1710, and in the 63d year of his age.

ALDROVANDI, Ulysses, a celebrated Italian naturalist, was born at Bologna in 1525, and became afterwards professor of philosophy and logic, and lecturer on botany in that university. But his name is transmitted to posterity as the laborious compiler of an extensive work on natural history. The expences which he incurred in the execution of this huge work reduced him to such poverty that he was compelled to seek an asylum in an hospital in Bologna, where he died in 1605, and in the 79th year of his age. The compilation which Aldrovandi projected, consists of thirteen folio volumes, which include all the departments of natural history; but the first six volumes only are to be considered as his work; the last seven volumes were drawn up on the same plan, and published after his death.

ALE, a fermented liquor obtained from an infusion of malt and hops, originally prepared, it is said, in Egypt, and used as a substitute for wine in those countries which are unfavourable to the production of the grape. See Brewing.

ALECTO, according to the heathen mythology, one of the three Furies, who is described as the daughter of Acheron and Night, or of Pluto and Proserpine.

ALEMBERT, John le Rond D', an eminent philosopher, was born at Paris in 1717. He was exposed by his mother near the church of Jean le Rond, from which he derives his name, and seemed so weak when discovered that scarcely any hope of life remained. The humanity of the commissary to whom such matters are intrusted, instead of consigning the infant to the ordinary receptacle destined for those whom parental affection has abandoned, committed him to the care of the wife of a glazier, and thus probably preserved his existence. The father of D'Alembert, touched with the kindness of strangers to his neglected offspring, came forward and provided for the education and independence of his child. D'Alembert was indebted to the Jansenists of the college of the Four Nations for the elements of learning, and his progress afforded early promise of rising genius. A commentary on the epistle of Paul to the Romans, which he composed in the first year of his philosophical studies, gave his masters the pleasing hope that their young pupil would become a second Pascal, and the means of reviving the ancient splendour of their establishment; but their expectations were soon disappointed, for nothing could allure him from mathematical and physical science, in which he then engaged.

When he retired from college, and found himself alone in the world, he returned to the house of his nurse, with the resolution of devoting himself to his favourite studies, and in this humble abode he spent 40 years of his life. To increase his scanty income, which did not exceed 1200 livres a-year, he was induced, by the advice of his friends, to turn his attention to some professional employment; and with this view he studied law, which he relinquished for medicine, and finally abandoned both, that he might prosecute mathematics without interruption. In the year 1741, and at the early age of 24, he was admitted a member of the Academy of Sciences. Two years afterwards appeared his Treatise on Dynamics, in which a new principle of mechanics is developed. The discovery of this new principle was followed by that of a new calculus, the first application of which was made in his discourse on the general theory of the winds, to which the prize medal of the academy of Berlin was adjudged in 1746. This treatise was dedicated to the great Frederick, in the following flattering verses, which obtained for their author a letter from the king, and the honour of being ranked among his literary friends:

Haec ego de ventis, dum ventorum ocyor alis,
Palantes agit Austriacos Fredericus, et orbi,
Insignis lauro, ramum prætendit olivae.

Swifter than winds, while of the winds I write,
The foes of conquering Frederick speed their flight;
While laurel o'er the hero's temple bends,
To the tir'd world the olive branch he sends.

In 1747 D'Alembert applied his new calculus to the problem of vibrating chords; in 1749 he furnished a method of applying his principle to the motion of any body of a given figure; in 1752 he published a *Treatise on the Resistance of Fluids*, and *Elements of the Theory and Practice of Music;* and about the same time his *Researches concerning the Integral Calculus*, appeared in the Memoirs of the Academy of Berlin. The reputation of D'Alembert was long confined to a small circle of friends, or only extended to those who were engaged in kindred studies; and indeed it does not appear that at any time he was very solicitous to obtrude himself on public notice. Of men of rank and station to whom he was known at this period, Messrs D'Argenson only are mentioned; but they were capable of appreciating his talents, and through their influence with the French king he was rewarded with a pension.

The publication of the Encyclopaedia, in conjunction with Diderot, exhibited a fine display of the varied powers and fertile genius of D'Alembert. The preliminary discourse on the origin, progress, and connections of the different branches of human knowledge, which he furnished to that celebrated work, has been universally acknowledged as a striking specimen of just arrangement and sound criticism, and a perfect model of accurate thinking and elegant writing; although a verbose hypercritic of the present day, after having studied and admired it for more than thirty years, has at last made the notable discovery, that the views of D'Alembert, as well as those of his great praecursor, the illustrious reformer of philosophy, Lord Bacon, are altogether erroneous; and, seemingly for the purpose of shewing with what dexterity he can wield the weapons of controversy in refuting their reasonings, at once pronounces them unsound and illogical. No great ingenuity or strength of arm is necessary to reduce the noblest building to a heap of ruins, but a powerful mind and vigorous exertion are required in the contrivance, arrangement, and disposition of the several parts of a grand edifice, to give solidity, uniformity, and elegance to the entire structure.

The unrestrained freedom of thought, and the little indulgence shewn to established opinions which appeared in the Encyclopædia, not only in religious and political affairs, but in the manners and more ordinary concerns of mankind, involved D'Alembert and his associates in much controversial discussion; and, perhaps with no great fairness or candour, the resentment and opposition which they had rashly provoked, are ascribed to a determined conspiracy, formed and supported by envy and detraction. While D'Alembert was suffering under literary persecution, the King of Prussia invited him to his court, with an offer of the place of President of the Academy; and, some time before, the Empress of Russia had solicited him to superintend the education of the Grand Duke; but he preferred the retirement and studious ease of private life to the dazzling honours and splendid distinctions of royal favour.

Beside the works already referred to, D'Alembert was the author of *Miscellanies*, philosophical and historical, &c.; *Researches* on several important points of the system of the world; *Elements of Philosophy;* and, in three years from the time when he was elected secretary to the French academy in 1772, he formed and executed the grand design of writing the lives of deceased members from 1700 to 1772, a work of great labour and industry, which included 70 *eloges* or biographical sketches.

Under the humble roof of his nurse, D'Alembert had spent the greater part of his life. A severe illness, in 1765, required him to remove to a more airy and healthy situation. He recovered his strength, and resumed his studies, which he continued to prosecute with ardour till his death in October 1783, and in the 66th year of his age. Candour, modesty, disinterestedness, beneficence, and simplicity of manners, are the amiable features in the character of D'Alembert; and his conversation, cheerful, lively, and full of anecdote, and the delicate sallies of his wit, not always unmixed with satire, rendered him an agreeable and interesting companion.

ALEMBIC, an old chemical vessel for distillation, now disused, and replaced by the commodious apparatus of the still and the retort.

ALENÇON, a small city of France, and capital of the department of Orne, is situated in a fertile plain on the banks of the river Sarte. The number of inhabitants exceeds 12,000; the chief manufactures are lace, linen, woollen stuffs, and leather; and it is 100 miles S. W. from Paris.

ALENTEJO, an extensive province of Portugal, which is bounded on the north by the Tagus, and on the west by the Atlantic ocean, is more than 100 miles in length, and nearly the same in breadth, and contains above 260,000 inhabitants. The soil is, in general, fertile, producing wheat, rye, barley, grapes, and olives, but the cultivation is very imperfect. This province has been often the seat of war, to which is ascribed its diminished population.

ALEPPO, or HALEB, the metropolis of modern Syria, and considered as the third city of the Ottoman empire, is situated in an extensive plain, which reaches from the Orontes to the Euphrates; is erected on eight hills, on the most elevated of which stands the castle; and is supposed by many to be the ancient Beræa. The ruins, still visible, sufficiently indicate its great antiquity. To the north-west of the castle, probably the site of the ancient city, marble pillars have been frequently discovered, at a considerable depth below the surface. Many of the streets of Aleppo are spacious and well paved, and in some of them a greater degree of cleanliness is preserved than in any other city of the Turkish empire. The houses are large and commodious, with terraced roofs; and the loftiness of the apartments, lighted from the top, with the gilded window-shutters, produces a striking effect at first entrance. The mosques are numerous, and some of them possess considerable magnificence. In an area before each, a fountain supplies the water which is required for ablutions before prayers. Aleppo is furnished with many large caravanserays, consisting of a spacious square, with a number of rooms on all sides of it, built on the ground-floor, which are occasionally employed as chambers, warehouses, or stables. The galleries on each side, on the second floor, are divided into many small apartments, where the natives and strangers transact the greater part of their mercantile affairs.

The market-places are long, narrow, covered streets, on each side of which are many small shops, barely sufficient to contain the tradesman and his goods, in consequence of which the purchaser must stand without. Each branch of business has its own market-place or *bazar*, which is locked up as well as the streets, about an hour and a half before sunset; and while the doors are cased with iron, the locks are made of wood. The suburbs contain the slaughter-houses, which are open to the fields; the

the tanners have a khan, in which they work in the vicinity of the river; a little below is a village, where ropes and catgut are manufactured; and coarse white glass is made on the opposite side of the river. The soil around Aleppo is rich and fertile; and the gardens, which are extensive, and well cultivated produce abundance of vegetables and delicious fruits. Aleppo is the emporium of Armenia and Diarbekir; sends caravans to Bagdad and Persia, and communicates with the Persian gulf and India by Bassorah, and with Europe by Alexandretta. Commerce is chiefly conducted by means of barter.

The air of Aleppo is dry and piercing, but, at the same time, salubrious; the summer heats are greatly moderated by the west winds. The population of Aleppo is, by some, computed at 285,000, while others state it so low as 100,000; but the estimate of Dr Russel, who resided there many years as physician to the British factory, makes the total amount 235,000, of whom 200,000 are Turks, 30,000 Christians, and the remainder Jews. With respect to religion, the people of Aleppo are more tolerant than the Turks of other countries; but they are said to be effeminate, and wholly averse to bodily exertions. The plague is supposed to appear in Aleppo once in ten years, and its ravages are sometimes terrible. The greater part of the time of the natives is spent in the prayers and ablutions prescribed by the Koran, in smoking tobacco, and in the immoderate use of the bath, the waters of which are often heated to about 100°. Aleppo lies 250 miles N. of Jerusalem. N. Lat. 35° 47′, E. Long. 37° 40′.

ALETRIS, a genus of plants belonging to the Hexandria class.

ALEUTIAN, or ALEUTSKY ISLANDS, are situated in the northern Pacific ocean, and form a chain of small islands, which extends from the promontory of Alaska, in North America, to the peninsula of Kamschatka, in the Russian territory. These islands have been divided into three groups; the first, called the *Fox islands*, lies nearest the American promontory; the central is called *Andrianofskoi*; and the third, properly called *Aleutian Islands*, is contiguous to the coast of Kamtschatka. They were little known till towards the middle of the 18th century. Peter the Great of Russia, a short time before his death, which happened in 1725, had projected a voyage of discovery in these remote regions, for the purpose of ascertaining the distance between the two continents of Asia and America; but the expedition did not take place till 1728, when Captain Behring was engaged in the enterprise; but it was not till he had made a third voyage in 1741 that the American coast was discovered; and on his return to Kamtschatka he was shipwrecked, and soon after died on the island which now bears his name. Numerous voyages were undertaken, either by private individuals or companies, for the purpose of hunting those animals which afford valuable furs, or, under the authority of government, for the purpose of farther discovery. The eastern part of this chain of islands was visited by Captain Cook, in 1778, during his last voyage. The whole were explored by Captain Billings, in 1796; and a still later expedition was appointed by the Russian government in 1803. The whole chain of the Aleutian islands is included within the 52° and 55° of N. Lat. and 169° and 183° of E. Long.

Behring's island, the most westward of the group, lies nearest to Kamtschatka; Copper island, which has been so denominated from masses of copper found on the beach, is situated ten leagues to the eastward; several small islands belong to this westerly group, which are succeeded by the central group, which is less known. The Fox islands, so called from the abundance of those animals found upon them, are the most important, and best known of the whole chain. Of this group, Umnak, Oonalashka, which is particularly described by Captain Cook, and Unimak, are the most considerable. The Aleutian islands exhibit a bare and mountainous aspect; their rocky coasts render navigation extremely dangerous, but some of them have commodious bays, and excellent anchoring places. The rocks seem to be of a basaltic nature; and in several of the islands volcanoes are still in a state of activity. The soil in the sheltered valleys produces abundance of grass; and in some of the islands it seemed fit for raising grain. The chief vegetable productions are of spontaneous growth, as bramble-berries, cran-berries, heath-berries, and some others; the only cultivated root is the potatoe, which has been lately introduced by the Russians, succeeds well, and is greatly relished by the natives. The dwarf birch, willow, and some other plants of shrubby growth, make the nearest approach to the character of trees; the wood employed in building is wafted from the American shores.

Among the land animals of the Aleutian islands, are enumerated bears, wolves, river otters, river beavers, and ermines; foxes, as black, grey, red, and brown, which abound in the Fox islands. The sea otter, whose fur is extremely valuable, seals, dolphins, and whales, are common in the neighbouring seas. Several kinds of salmon, cod, herrings, and holibut, of a very large size, are abundant.

The population of these islands is stated to have been at one time very considerable, but it is now greatly diminished, owing, it is said, partly to the oppression to which they are subject, and the change in their mode of life since they came under the Russian dominion, and partly to many of the hunters being sent to a distance, in chace of the large sea otter, and few of them returning from this dangerous occupation. The dress of the natives, which is nearly the same both in men and women, is chiefly composed of seal skins, and consists of a kind of frock, or shirt. Fish, sea animals, birds, roots, and berries, form the chief part of their food, and it is generally eaten in a raw state. Their habitations are merely holes dug in the earth, which are covered with a wooden roof, over which a quantity of grass and loose soil is thrown, giving their villages somewhat of the appearance of a church-yard. The entrance is by the roof; and through an opening in it, covered with a dry fish skin, the light is also admitted. The inhabitants, who are of low stature and of a swarthy complexion, are described as an honest, peaceable, and inoffensive people; but when their passions are roused, they become extremely furious, fearless of danger, and indifferent to death itself. The dreadful vengeance which they have more than once executed on the Russian adventurers, in massacring the whole crew of some of their ships when opportunity offered, may be regarded rather as a severe retribution for the oppression and cruelty which they suffered from rapacious traders, than as a mark of a barbarous disposition.

With the knife and hatchet alone, the latter a very rude instrument, the natives of these islands construct all their domestic utensils, and contrive to give them some degree of elegance and ornament. A needle is formed of the wing-bone of a bird; and with this all kinds of sewing, and a coarse sort of embroidery, are executed by the women. The Aleutian canoe is a frame of wood covered with leather made of seals-skins. It is usually constructed for a single person, sometimes for two, and very rarely for three, and is so light that it may be easily lifted up with one hand. The dart or javelin is employed in the destruction of prey, whether winged, land, or sea animals; and in the use of this weapon, which is discharged from a small board, the islanders display great dexterity.

Dancing is a favourite amusement. A small drum, and a rattle composed of a dried membranous bag, in which are introduced peas or small pebbles, are their only musical instruments. Their vacant hours in the long winter evenings are filled up with the manufacture of fine mats, small baskets, and pocket-books of straw, which are constructed with much neatness, and are not destitute of elegance. Toys, in the figure of men, fish, and such animals as are familiar to their observation, are made of the teeth of the sea cow, a substance whose hardness is greater than ivory, and which is brought into shape more by manual dexterity than by the perfection of the instruments employed. The houses have no fire-place; they are heated, as well as lighted, in the winter season, with lamps which are formed of a flat stone, with a concavity in the middle to receive the oil. A little dry grass serves the purpose of a wick.

The natives of the Aleutian islands, since their intercourse with Russia, are professedly attached to the Greek church; but, without intellectual culture, it is no wonder that their minds are still deeply obscured by the gloom of superstition. Marriage is marked by no nuptial ceremony; and the number of wives is only limited by choice, or the means of support. The sale or exchange of wives is said not to be uncommon. Many ceremonial rites were formerly observed in the burial of the dead; their best clothes and javelins, and a portion of oil and food were deposited with them in the grave; and, in the barbarous period of their history, the horrid sacrifice of slaves of both sexes was practised.

The fur-trade is the great object of Russian enterprize in these remote regions. It was originally in the hands of private adventurers, whose cruelty and rapacity at one time threatened the total extirpation both of the inhabitants and the animals on which it depended. The establishment of companies under the authority of government, and the introduction of regulations, have, in some degree, improved it; but the rapid decline of the population is a melancholy and certain proof of the oppression and poverty to which the unfortunate islanders are still subjected. The fur of the sea-otter is esteemed the most valuable; but the increasing destruction of these animals has greatly diminished their number, and made them rare in these islands. The furs of foxes of different colours, as black, red, brown, grey, or blue, are also in great estimation. The furs collected in the Aleutian islands are a source of great commercial wealth to the Russians; and the most lucrative branch of the trade extends to the Chinese empire.

ALEXANDER THE GREAT, the son of Philip of Macedon, and the most celebrated military character in ancient history, was born about 355 years before Christ. The father, the most able general and profoundest politician of the age, was indefatigable in his exertions to destroy the liberties of Greece, and boundless in his ambition to extend the Macedonian power. Dissensions, and mutual distrust, among the Grecian states, had opposed their co-operation in attempting the invasion of Persia; but when the whole were subject to the dominion of Philip, he was placed at the head of the combined forces of Greece, and immediately prepared to carry into effect the long projected plan; but he was prematurely murdered, and, in consequence of a misunderstanding which had existed between the father and son, on account of Olympias, the mother of the latter, having been divorced, Alexander was not free from the suspicion of being an accomplice in the horrid deed.

Alexander gave early indications of splendid talents and powerful military capacity; but the aversion of the Greeks to the usurped authority of Philip, the youth of his successor, then only in his twentieth year, and the determined opposition of the orator Demosthenes to his whole house, induced them to seize this opportunity of throwing off the yoke; and while Alexander was absent in reducing some barbarous countries to submission, the Thebans, who had been encouraged by the report of his death, rose in open rebellion. In returning to quell it, the rapidity of his march at once astonished and disconcerted the insurgents; they were forced to an engagement; Thebes, after a desperate resistance, was taken by storm; the buildings, with the exception of the house of Pindar the poet, were levelled with the ground, and 30,000 of the inhabitants were sold as slaves. This severe measure overawed the Grecian states, and repressed any future attempt at the recovery of their independence.

The tranquillity of Greece seemed to afford a fit opportunity for resuming the favourite scheme of the invasion of Persia. All Greece, the Lacedæmonians excepted, united in the enterprise; and at an assembly of the states, held at Corinth, Alexander was chosen the leader of their armies. With an army of 30,000 foot and 5000 horse, a force seemingly altogether unequal to so arduous an attempt, he crossed the Hellespont, where the generals of Darius, with 100,000 foot and 20,000 horse, were prepared to meet him. The position of the enemy on the banks of the Granicus obliged Alexander to cross that river before he could give them battle. He threw himself into the stream at the head of some troops of horse, and was in great danger before the whole of his little army had effected the passage of the river. The attack was so sudden and unexpected, that the Persians fled with the utmost precipitation and disorder; and the slaughter was so terrible, that they lost 20,000 foot, and more than 2000 horse. The city of Sardis, with its immense wealth, fell into his hands as the consequence of this victory.

The Macedonian hero opened his next campaign in the spring; and having overrun Paphlagonia and Cappadocia, he advanced by rapid marches into Cilicia. The attack of a fever, which was induced by bathing in the river Cydnus, threw his army into some confusion; but his recovery, at the end of three days, revived their confidence, and enabled him to advance to meet the Persian monarch, at the head of an army of 600,000 men. Darius, by some unaccountable infatuation, left the open country, and took up a position in the narrow defiles of Cilicia. The two armies having passed each other in the night, met at Issus, where a dreadful engagement took place. The crowded ranks of the Persians seemed only calculated to accelerate their destruction; and more than 100,000 men are recorded to have fallen in this bloody conflict.

In following up this decisive victory, Alexander determined to make himself master of all the cities on the coast; and though he had received the submission of the inhabitants of Tyre by their deputies, yet they declined to admit him within the walls; and it was not till after a seven months siege that he obtained possession of the city. He then directed his steps towards Egypt, at that time subject to Persia; and glad of an opportunity of being rescued from that yoke, welcomed him as its deliverer. On a visit to the temple of Jupiter-Ammon, Alexander was honoured and flattered with the title of *Son of Jupiter*. When Alexander returned to Tyre, he received a proposition from Darius, to surrender the whole country between the Euphrates and the Hellespont; but the ambition of the conqueror was not bounded by such limits; and the refusal was followed by another sanguinary conflict, which took place near Arbela; in which the Persians had an army of 600,000 foot and 40,000 horse, while the army of Alexander amounted only to 40,000 foot and about 8000 cavalry. The battle was dreadful, and the Persians were totally routed, with the loss of half their army. This victory decided the fate of Persia. Alexander entered Babylon, and the murder of Darius, which was soon after perpetrated by his rebellious subjects, left him entire master of the country.

Alexander now resolved to carry his victorious arms to more distant regions in the east; and had proceeded as far as the river Hyphasis, which is supposed to be the modern Beyah; but the murmurs of his soldiers had increased to insubordination, and he was compelled to abandon the attempt. Resigning all prospects of future conquest, he determined to explore the country which he had already traversed. Crocodiles were observed in the rivers which fall into the Indus, and as they were supposed to exist only in the Nile, or its tributary streams, he concluded that he had discovered the sources of that celebrated river. With this view, he prepared a fleet to proceed to Egypt. An adventurous voyage of nine months brought him to the ocean. He ordered the fleet to sail through the Persian gulf, and then to ascend the Tigris, for the purpose of meeting him and his army in Mesopotamia, while he conducted his forces by land to Babylon. He accomplished the arduous journey with the loss of a fourth part of his army. At Babylon, he began to meditate new schemes of future conquest; but here his career of glory terminated by his death, which happened 323 years before the Christian era, and in the 33d year of his age.

"Alexander," says Dr Gillies, "was of a low stature, and somewhat deformed; but the activity and elevation of his mind animated and ennobled his frame. By a life of continual labour, and by an early and habitual practice of the gymnastic exercises, he had hardened his body against the impressions of cold and heat, hunger and thirst, and prepared his robust constitution for bearing such exertions of strength and activity as have appeared incredible to the undisciplined softness of modern times. In generosity and prowess he rivalled the greatest heroes of antiquity; and in the race of glory, having finally outstripped all competitors, became ambitious to surpass himself. His superior skill in war gave uninterrupted success to his arms; and his natural humanity, enlightened by the philosophy of Greece, taught him to improve his conquests to the best interests of mankind. His actions were not always blameless; but his faults were few in number, and resulted from his situation rather than from his character."

Tomb of Alexander.—The body of this renowned monarch, after his death, was enshrined in a golden chase-work, fitted to the skin, and covered with a garment also of gold, over which was thrown a purple robe, and the whole was enclosed in his armour. The preparations for his funeral, which was conducted in a style of unexampled magnificence, occupied two years. The body, placed in a splendid car, was conveyed with great pomp from Babylon to Alexandria, and deposited in the tomb constructed for it by Ptolemy. The tomb was held in great veneration, and even worshipped by the Egyptians; three hundred years after Alexander's death, the Roman emperor Augustus beheld the body of the conqueror still entire; and even the Mahometans, long after the body had been removed, regarded the sarcophagus with pious respect. It was seized by the French, and put on board a ship to be transported as a rich trophy to France; but when Alexandria fell into the hands of the British in 1801, it was included in the surrender.

This precious relic of antiquity, which is now deposited in the British Museum, is composed of a single block of Egyptian breccia, ten feet long, about five feet broad, and nearly four feet high. It is sculptured all over with an innumerable variety of hieroglyphic figures, some of which, from the durable quality of the stone, are, after the lapse of more than 2000 years, in excellent preservation.

ALEXANDRETTA, called by the Turks Scanderoon, is the port of Aleppo, and situated in the gulph of Ajazzo, about 70 miles from the city. The harbour affords good anchorage; but the land-winds, to which it is exposed, sometimes make vessels drag their anchors for many miles, and render it impossible to enter it during some months of the year. A marshy plain on the land side surrounds Alexandretta, in consequence of which it is extremely unhealthy. A malignant fever prevails from May to September, by the ravages of which the whole crew of a ship has been cut off in a few months. That the natives breathe a very insalubrious air at all seasons, is manifest from their sickly, cadaverous appearance. Thus, hostile to health, Alexandretta derives all its importance from being the port of Aleppo.

ALEXANDRIA, called Scanderia by the Turks, is a city of Lower Egypt, lying on the Mediterranean. Although this city has now dwindled into insignificance, it was once the most flourishing and highly celebrated in the world, the populous capital of the Egyptian monarchs, and for ages the grand emporium of commerce and of riches. Alexander the Great was its founder, who gave it his own name, 333 years before Christ; and it is believed to be the only surviving monument of the extensive conquests of that far-famed hero. The immense importance of commerce, and the almost endless resources of a maritime power, were no doubt suggested to Alexander by the severe check which his triumphant career suffered before the city of Tyre, and probably led him to found Alexandria, after the conquest of Egypt; a city which flourished for ages, and engrossed the commerce of the eastern and western worlds, before a passage was discovered to the Indies by the Cape of Good Hope.

Alexander himself is said to have marked out the plan of this city; the celebrated Dinocrates, who rebuilt the temple of Diana at Ephesus, was the architect; and when the conqueror returned from his excursion into Upper Egypt, which lasted about a year, the building was far advanced. The streets were uncommonly splendid and spacious; one of them, 2000 feet broad, which extended in length from the gate of the sea to that of Canopus, was intersected at right angles by another of the same breadth, so that at their junction they formed a square of $1\frac{1}{7}$ mile in circumference. The greatest glory of this city was its harbour, a deep and secure bay in the Mediterranean, in which numerous fleets might ride in perfect security. The palace and gardens of the Ptolemies, monarchs to whom Alexandria was indebted for much of its glory, were situated near the promontory of Lectreos, and contained within their inclosures the Museum, an asylum for men of letters, groves and noble buildings, and a temple in which Alexander's remains were deposited. Alexandria became the royal residence, A.M. 3700, in the reign of Ptolemy Soter, who founded the famous Alexandrian library, containing at last 700,000 volumes. This city passed into the hands of the Romans on the death of Cleopatra; and under the Greeks and Romans, as well as the Ptolemies, it continued, for almost 1000 years, to maintain its reputation for wealth and literature; but under the dominion of the Saracens, it fell into a state of insignificance from which it never recovered. In the year 639, after a siege of fourteen months, Alexandria yielded to the arms of the Saracens, by whom its celebrated library was doomed to destruction, for the notable reason assigned by the caliph, " If the writings of the Greeks agree with the Koran, they are useless; if they disagree, they are pernicious, and must be destroyed." The precious contents of this splendid library supplied fuel to the 4000 baths of the city, among which they were distributed, for six weeks; and in that period, if the account be not exaggerated, were scarcely consumed.

In the present day, Alexandria exhibits a singular scene of magnificent ruin and desolation; the remains of obelisks, capitals, pilasters, and broken monuments of ancient art. The Pharos was long ago demolished, and a square castle, at once destitute of strength, ornament, and taste, was erected in its stead. The lake Mareotis no longer exists; its place is occupied by the Lybian sands. The modern city stands near the brink of the sea; the houses have flat, terraced roofs, and the streets are narrow and incommodious. The number of inhabitants does not exceed 5000. The language is Arabic; but most of the people are acquainted with the Italian. Alexandria was carried by assault on the 4th of July 1798, by the French under Bonaparte; in 1801, it was taken by the British, and was restored to the Turks at the termination of the war, in whose hands it still continues. N. Lat. 31° 11′, E. Long. 30° 16′.

Some other remarkable remains of ancient magnificence are still visible in Alexandria or its vicinity. The obelisks, which are known by the name of Cleopatra's needles, are composed of a single stone, 60 feet in height, and seven feet square at the base. They are covered with hieroglyphics. One of them is thrown down, and is nearly buried in the sand, but the other still remains on its pedestal. Some suppose that these columns decorated the entrance of the palace of the Ptolemies, the ruins of which still exist at no great distance.

Pompey's Pillar.—This celebrated column, which has attracted the attention of all travellers, and has been a fertile subject of conjecture among antiquarians, is situated about a quarter of a league from the southern gate of Alexandria. It is composed of red granite, or syenite of modern mineralogists, which is brought from Upper Egypt. The shaft, which is 90 feet in length, and nine feet in diameter, is supported by a block of marble 15 feet square, and the Corinthian capital is nine feet high; the height of the whole column is 114 feet. This column is not mentioned by ancient historians. Abulfeda, who describes Egypt, calls it the pillar of Severus, from which it is concluded that it is a monument erected to the memory of that emperor. The name of Pompey's pillar was not known till the 15th century, about the time of the revival of learning. Denon, who visited Egypt, in 1798, along with the French army, has entered into some ingenious speculations concerning this column; and considering that the pedestal and capital are of a different stone from the shaft, that their workmanship is heavy, and appears to be merely a rough draught, and that the foundations, composed of fragments, indicate a

Alfred.

modern construction, concludes, that this monument is not antique, and that it may have been erected in the time of the Greek emperors, or of the caliphs; and seems to hint, that the shaft at least belonged to some ancient edifice, and that it ought to be regarded merely as a fragment.

Catacombs.—The catacombs, or ancient burial-place of Alexandria, are at the distance of a mile south-west from the city. This necropolis, or city of the dead, is dug in a bed of solid rock; the excavation is from 30 to 40 feet wide, 200 feet long, and about 25 feet deep. From this proceed several openings about 10 or 12 feet in width, which form subterranean streets, one of which has been particularly examined, and it appears that niches 20 inches square, sunk 6 feet horizontally, narrowed at the bottom, and separated from each other by partitions in the rock, 7 or 8 inches thick, divide into checkers the two walls of this subterranean vault. The mummies, or embalmed bodies of the dead, seem to have been introduced with the feet foremost, into the cells intended for their reception.

ALFRED, King of England, from the splendour of his talents and the lustre of his reign, justly designated the Great, was the youngest son of Ethelwolf king of the West Saxons, was born at Wantage in Berkshire, in the year 849; and in 871, while in the 22d year of his age, succeeded his brother Ethelred on the throne. A large proportion of England was at this time occupied by the Danes; and, in the very commencement of his reign, Alfred took the field to resist their farther inroads. Various success for some time attended his arms; but at last the fortune of war changed, and he was reduced to such extremities, that he was abandoned by his subjects, and assuming the dress of a peasant, was obliged, in that disguise, to seek a temporary asylum in the cottage of a neat-herd; and historians have not thought it unworthy of record, that he submitted to reproof for negligence in the humblest menial offices. The total discomfiture of a considerable army of the Danes, and the capture of their magical standard, the possession of which was believed to render them invincible, in a bold attack of one of his adherents, revived the hopes of Alfred, and encouraged him, in concert with his nobility, with whom he secretly corresponded, to rally his scattered forces. But before active warfare commenced, Alfred, in the assumed character of a harper, entered the Danish camp, and carefully examined the strength and position of the enemy, returned to his friends, quickly assembled his forces, and, in an attack as sudden as it was unexpected, obtained a complete victory. The consequences of this victory were the recovery of London, a considerable extension of his dominions, and a period of several years tranquillity, which he wisely improved by strengthening and securing himself against future invasion. The repose of the kingdom was again disturbed in 893 by the arrival of a powerful fleet and a formidable army of Danes, who, aided by an insurrection of their countrymen formerly established in England, threatened the total overthrow of the power of Alfred. After a severe struggle, he was again successful, drove them from his dominions, and, by his wisdom and vigour, preserved a profound peace during the last years of his glorious reign. Alfred, who is considered as the founder of the English monarchy, held the reins of government about thirty years. He died in 901, in the 52d year of his age, and was succeeded on the throne by his youngest son Edward.

Alfred.

Alfred may be regarded as one of those prodigies of intellectual endowment which has no equal in the age and country in which he lived. No monarch ever acquired or merited the love, esteem, and veneration of his subjects more than Alfred; and not only on account of the dazzling qualities of his military character, but by an irresistible impulse of gratitude and admiration—gratitude for the inestimable benefits of his civil administration—and admiration of the amiable virtues of his private character. Many of the most useful domestic arrangements and some of the wisest political institutions, derive their origin from him. The naval power was improved and extended, and the militia regulated and strengthened; a code of laws, which is supposed to have been the foundation of the common law of England, was drawn up under his authority; courts and well qualified judges were appointed; the kingdom was divided into counties, hundreds, and tythings; commerce and manufactures were introduced and encouraged; the instruction of the people was promoted; schools and colleges were endowed at Oxford; and scholars were invited to his court.

Although it is stated that Alfred was in his 12th year before a proper person could be found to instruct him in the elements of learning, yet he became eminent as a grammarian, mathematician, and historian; was esteemed the best Saxon poet of his time, and composed in verse various parables and fables for the instruction of his people. He translated the fables of Æsop; the Consolation of Philosophy by Boethius; Bede's Ecclesiastical History, and, it is said also, the Old and New Testaments. The regular distribution of time which Alfred observed, affords a useful lesson to the studious and industrious. The 24 hours were divided into three parts; eight hours were allotted to devotion and literary pursuits; eight were devoted to public affairs, and eight were occupied at his meals, in sleep, and exercise. To note these divisions of time, six wax candles, each of which burnt four hours, were employed during the 24. Each candle was 12 inches long, and each inch, which was consumed in the third part of an hour, was marked with a circular coloured line; and to insure their equal combustion, they were inclosed in horn lanterns, for the purpose of protection in windy weather. The care of these candles was entrusted to the keepers of his chapel, who gave notice of the lapse of time.

The expenditure of Alfred was subjected to a similar methodical arrangement. One part was devoted to charitable purposes, and divided into four portions; the first for alms to the poor, the second for the relief of indigent monks, the third for the support of monasteries, and the fourth for the maintenance of professors and students. The other half was divided into three parts; the first was applied to the expenses of his household, the second for the payment of ingenious artists, and the third to learned foreigners who had been invited into the kingdom.

ALGAE, Flags, the third order of the Cryptogamia, or 24th class of the Linnean system, including under it sea-weeds and some other aquatic plants.

ALGAROTTI, Francis, an Italian author of considerable celebrity, was born at Venice in December 1712; was educated at Bologna; and, during his travels in France and England, became attached to the Newtonian philosophy, of which he published a popular illustration, entitled *Newtonianism for the Ladies.* At Berlin he acquired the favour and friendship of Frederic, king of Prussia, who honoured him with the title of Count. He published also some ingenious speculations on light and colours, possessed considerable critical knowledge in music, painting, sculpture, and architecture, and contributed much to the reformation and improvement of the Italian opera. His works afford ample testimony of his genius and erudition, and they are often distinguished by elegant composition and lively sallies of wit; but the vanity, affectation, and selfishness of his character were intolerable. Perhaps no better proof is needed, than the ambiguous inscription which he composed, and which was inscribed on the tomb erected by himself at Pisa: *Hic jacet Algarottus, sed non omnis:* Here lies Algarotti, but not the whole of him,—may refer, either to his belief in the immortality of the soul, or to the lasting reputation to which he flattered himself his works were entitled. He died at Pisa, in May 1764.

ALGARVA, the most southern province of Portugal, is bounded on the south and west by the Atlantic ocean; on the east by the river Guadiana, which separates it from Spain; and on the north by a mountainous ridge, which forms the division between it and Alentejo. In some places it is tolerably fertile, producing oil, wine, and fruits. The population is between 60,000 and 70,000; and the inhabitants on the sea-coast, who are engaged in fisheries, are the best mariners in the kingdom.

ALGEBRA, or Universal Arithmetic, from its more extensive application than common arithmetic, is employed in discovering the relations which exist among different quantities, in respect of their magnitudes. See Mathematics.

ALGEZIRAS, or Old Gibraltar, a sea-port town of Andalusia in Spain, situated on the coast of the straits of Gibraltar. By this town the Moors entered Spain in 713, and they were expelled from it in 1344, on which occasion, it is said, cannon were first employed. Algeziras is about 10 miles distant from Gibraltar.

ALGIERS, a kingdom of the northern part of Africa, stretching along the coast of the Mediterranean, and including the ancient Numidia and a portion of the ancient Mauritania, is usually considered as one of the states of Barbary. See Barbary.

ALGIERS, supposed to be the ancient Icosium, is the capital of the kingdom of Algiers, derives its name from the Arabic, which signifies *the island*, in consequence of the island before the city, which is now united to it by a mole or pier; and from its situation on the declivity of a hill, and arrangement in the form of an amphitheatre, presents, when seen from sea, a grand and striking spectacle. Excepting the principal street, which runs from east to west, and contains the best shops and warehouses, the streets of Algiers are narrow, incommodious, and dirty. The whitened roofs of the houses rising in regular gradation, exhibit some resemblance to the top-sails of a ship; and their flatness affords an easy communication for the whole length of a street. The houses have a square court in the middle, are constructed with galleries all round, rise to a considerable height, and are furnished with very small windows. The palace of the Dey, and some of the mosques, are the chief public edifices; but they are more distinguished by their magnitude than remarkable for beauty or elegance. The public baths, as is usual in Turkish towns, are numerous. A spring, issuing from a neighbouring hill, supplies Algiers with water, which is conveyed in pipes, and discharged from many public fountains, and each house is provided with a cistern for the reception of rain-water. The town of Algiers is surrounded with walls; has five gates, which are constantly shut during the night; and is farther protected by seven castles, which are well furnished with great guns.

The harbour of Algiers is commodious; the mole extends 500 paces from the land to the island, from which the name is derived; and is protected by a castle and strong battery, erected on this insular spot. Although Algiers is described as being only half a league in circumference, the population is stated, perhaps on no certain authority, at 120,000; of whom one half consists of Moors or Berebbers, 16,000 are Turks, 30,000 are Cologlies, or descendants of Turks and Moors; and Jews, Christians, and renegadoes, make up the remainder.

ALGONQUINS, a race of Indians in North America, which formerly spread over great part of Lower Canada. This race exists now only in small tribes; and, from the precarious nature of their subsistence, which is derived from fishing and hunting, is fast diminishing.

ALHAMBRA, signifying the *red house*, is the ancient palace of the Moorish kings in the city of Granada in Spain, is situated on one of the hills on which the city is built, was begun in 1280 by the second Moorish king of Granada, and was completed by his successors, each of whom added something to its extent and beauty. The lofty situation of the Alhambra affords a wide view of a fertile country. The external aspect of this palace presents a huge mass of uncouth buildings, thrown together without order and without design; and it should be regarded as a singular production, both in the style of its architecture and the character and arrangement of its ornaments. But the interior, with its marble pavements, numerous baths and fountains, fret-work in stucco, and mosaic work on the walls and cielings, groups of columns, and painting in gold and azure, exhibits altogether a magic scene, or a kind of fairy-land. Connected with one side of the ancient palace, a grand edifice, two hundred Spanish feet square, in a very magnificent style, was erected by the emperor Charles V. but it was left unfinished. For an account of the Alhambra, the reader is referred to Swinburne's *Travels*, in which are given drawings of the principal parts, without which scarcely any description could be rendered intelligible.

ALI, a remarkable character in Mahometan history, was the son of Abu Taleb, and cousin of Mahomet, with whom he early and ardently co-operated in the establishment and propagation of the new religion; and, on account of his zealous services, he was hailed by Mahomet as his vizier or assistant, his brother and vicegerent. He was greatly distinguished by his eloquence, and not less celebrated for his valour, which obtained for him, according to the bold metaphorical expression of Eastern languages, the surname of the *Lion of God, always victorious.* Ali had married the daughter of Mahomet; and from this connexion, as well as being his nearest relation by blood, aspired at being his successor; but Abu Beer, the father-in-law of the prophet, and two others, Omar and Othman, reigned before him. The death of Othman opened his way to the sovereignty, which he at first declined, and was only prevailed with to accept of it by the entreaties of his friends and the threats of the people; but his short reign, of scarcely five years, was incessantly harassed by insurrections and rebellions, excited and supported by formidable competitors. He was wounded by the hand of an assassin with a poisoned weapon at the door of the mosque, and he died in a few days, in the 63d year of his age, in the year 660 of the Christian era, and the 40th of the Hegira. The followers or sect of Ali regard him and his descendants as the only legitimate successors of Mahomet, and consider all the caliphs who are not of this family as usurpers. A green turban is their distinguishing characteristic. The Persians are the chief adherents of this sect, and the Turks belong to the sect of Omar, and hold Ali and his followers in execration.

ALI BEY, an eastern adventurer, was a native of Mount Caucasus; and about the age of 12 or 14 was sold as a slave in Cairo, and purchased by two Jews, who presented him to Ibrahim, an officer of the janizaries, and at that time one of the leading men in Egypt. This country was then under the government of twenty-four beys, eight of whom had been selected from the household of Ibrahim. Ali, growing in favour with his master, obtained his freedom; was first appointed to the government of a district, and afterwards elected one of the twenty-four beys. The death of Ibrahim, in 1757, opened a wide field for his ambition, and led him to aspire after the entire sovereignty of the country; but the failure of his first attempt obliged him to retire for safety into Upper Egypt. After an absence of two years, he returned suddenly to Cairo; and in one night he either put to death or expelled those beys who were his enemies. He banished the Turkish pacha,—set the authority of the Ottoman Porte at open defiance,—fitted out vessels on the Red Sea,—seized on the port of Djedda, and plundered Mecca. Ali next formed a plan for the conquest of Syria; and uniting his forces in 1770 with Daher, another rebellious insurgent against the Porte, besieged Damascus. The city was taken; but the castle was saved by the treachery of Mohammed Bey, Ali's commander, who suddenly drew off his forces, and retired to Egypt. An open war now commenced between Ali and Mohammed; and after a long struggle, and various success, Ali was wounded and taken prisoner, was carried to Mohammed, and died in three days, either in consequence of his wound or of poison. This bold adventurer possessed considerable talents and great intrepidity. The vigour of his administration in the suppression of plunderers and robbers, gave greater security to Egypt than it had hitherto enjoyed; but he was rash and impetuous, and his excessive confidence in some of his adherents and favourites ruined his schemes.

ALIBI, a Latin word, which signifies *elsewhere,* is a term employed in the criminal law of this country; as, when a person charged with a crime attempts to prove that he was in a different place, or elsewhere, when it was committed, or pleads an *alibi.*

ALICANT, a sea-port town of Valencia, in Spain, is situated on a narrow neck of land, which projects a considerable way into the sea, and is protected by a strongly fortified castle, on the summit of a rocky mountain, which rises behind the town. At the beginning of the 16th century, six houses only stood on this spot; but before its termination it contained more than 1000, owing, it is said, to its secure situation from the depredations of pirates, who then infested the coasts of the Mediterranean. The population is stated at 17,000; and the principal trade is in barilla, fruit, and wine, especially the famous *tent wine.* Alicant is 75 miles S. of Valencia, and 37 N.E. from Murcia; in N. Lat. 38° and W. Long. 0° 24′.

ALICATA, the ancient LEOCATA, a town of Sicily, situated on a peninsula, in the valley of Mazara, contains about 10,000 inhabitants, and has a considerable trade in corn and wine. It is 22 miles S. E. from Girgenti.

ALICUDA, one of the Lipari isles, on the northern coast of Sicily, contains about 500 inhabitants, whose houses are built at considerable elevations on the declivity of the mountains. The chief productions of this island are Indian figs, olive trees, and vines, which afford an excellent wine, with some barley and wheat. No springs of fresh water are found on the island, so that the inhabitants suffer great inconvenience and distress during a long course of drought. Alicuda is considered by some geologists as a volcanic production.

ALIEN, from the word *alienus,* which signifies a stranger or foreigner, is a person born out of the kingdom, and under the dominion of a foreign government. In this country peculiar laws have been enacted with regard to aliens. By the law of Scotland, no alien is capable of acquiring or succeeding to heritable property, without being naturalised by an act of parliament. No alien can vote for a member of parliament, or sit in the house of commons; but children born in a foreign country, whose fathers are citizens, or natural born subjects at the time of the birth of their children, are regarded as natural born subjects of Great Britain, unless by treason or felony, or being in the service of a foreign state at war with Britain, the fathers have forfeited their privileges.

ALIENATION is the act of making over or disposing to another person the property of lands, tenements, &c. Alienation in fee, is the transference of the fee-simple of any land or other right. Alienation in mortmain, is the transference of lands or other heritage to a religious house, or corporation, which is not permitted without a licence from the king.

ALIMENT, or ALIMENTS, are those substances, whether of a vegetable or animal nature, which are destined for the nourishment of animals. See DIETETICS.

ALIQUANT PART, is a number which cannot measure a greater number without a remainder: thus, 4 is an aliquant part of 13, because three times 4 is 12, and is deficient by one; and 4 times 4 is 16, and exceeds the number by three.

ALIQUOT PART, is that part of any number or magnitude which divides it without a remainder: thus 3 is an aliquot part of 18, and 8 of 24.

ALISMA, Water Plantain, a genus of plants belonging to the Hexandria class, of which four species are natives of Britain.

ALKAHEST, or ALCAHEST, signifying *all spirit*, or *spirit of salt*, was one of the great objects among the pursuits of the alchemists, and denotes the *universal solvent* which possessed the property of resolving all bodies into their first principles, or of dissolving all substances into a simple uniform fluid.

ALKALI, is applied to a class of bodies which have a peculiar acrid taste, have a strong affinity for water, and combine with it in large proportion, change vegetable blue colours to green, and brown colours to yellow; corrode animal substances, and unite with oily and fatty matters, and form soaps, and with acids forming neutral salts. Three substances, potash, soda, and ammonia, possess these distinct properties. Two of them, potash and soda, are called *fixed alkalis*, because they require a very strong heat to volatilize them; and ammonia is denominated *volatile alkali*, because, with a moderate heat, it assumes the gaseous form. The recent discoveries of Sir H. Davy, which constitute a brilliant era in chemical science, have shewn that the alkalis are oxides of peculiar metals, or are compounds of a metallic base and oxygen. See CHEMISTRY.

ALKERMES, an old term for a cordial confection, deriving its name from the kermes berries employed in its composition.

ALKOHOL, or spirit of wine, a colourless transparent liquid, which is the product of the distillation of fermented liquors, as wine or beer. See CHEMISTRY.

ALKORAN, or the KORAN, the Scriptures of the Mahometans, containing their doctrines and precepts as they were revealed to the prophet. See KORAN.

ALL-SAINTS, or ALL-HALLOWS, a festival held on the first of November by the Church of Rome, as a general commemoration of the saints; introduced into Italy in the 9th century by Boniface IV. and soon after adopted in other churches.

ALL-SAINTS, a spacious harbour or bay on the coast of Brazil in South America, is about eight miles broad, and is studded with numerous small islands. It is also the name of a rich and fertile district of Brazil, which produces great quantities of cotton and sugar, and contains several town and cities, of which St. Salvador is the capital. All-saints bay is in S. Lat. 12° 3'. and in W. Long. 40° 10'.

ALL-SOULS, a festival of the Romish Church celebrated on the 2d of November, in commemoration of all the faithful deceased, was first introduced in the 11th century.

ALLA, or ALLAH, the name by which the Supreme Being is addressed by the followers of Mahomet, is derived from the Arabic verb, *alah* to *adore*, and is synonymous with the Hebrew *Eloah*, signifying the *Adorable Being*.

ALLAHABAD, a province of Hindostan, including a space of more than 19000 square miles, is bounded on the east by the province of Bahar, and on the north by that of Oude; according to its ancient division, is distributed into ten circars; formerly contributed to the public service nearly 250,000 troops; and the greater part of it is now under the dominion of the British power. The principal cities are Allahabad and Benares.

ALLAHABAD, the capital of the province of the same name, is supposed by Dr Robertson to be on the site of the ancient Palibothra, while Major Rennel thinks that Patna is built on the spot formerly occupied by that famous city. Allahabad is situated at the confluence of the Ganges and Jumna, and is divided into the *old* and *new* towns; the former stands on the banks of the Ganges, and the latter on those of the Jumna. The fortress, erected by the emperor Akbar, and occupying a large space within the city, a pillar of a single stone, 40 feet high, and the splendid tomb of the Sultan Khufru, afford excellent specimens of oriental architecture. Allahabad is held in high veneration, is distinguished by the name of "the king of worshipped places," is the great resort of pilgrims, and the space of 20 miles round the city is deemed holy ground. N. Lat. 25° 27'. E. Long. 82° 5'.

ALLAN, DAVID, an eminent historical painter, who has been sometimes designated the Hogarth of Scotland, from the peculiar character of some of his productions, was born at Alloa in February 1744. The early indications of mechanical dexterity which he exhibited with no other instrument than a knife, attracted the notice of Mr Stewart of the customs, in his native place, and obtained for him, from that gentleman, a recommendation to the academy of painting, under the superintendence of the Messrs Foulis, the celebrated printers at Glasgow, where he was admitted and remained seven years. The liberality of Mrs Erskine of Mar, Lady Charlotte Erskine, Lord Cathcart, and Mr Abercromby of Tullibody, enabled the young artist to visit Italy, and to study the sublime productions of the pencil and the chissel in the imperial seat of the fine arts. The generous kindness of his patrons was not disappointed; for in 1773 he produced the best specimen of historical composition, the subject of which was the Origin of Painting, and obtained the prize medal of the academy of St. Luke at Rome.

After a residence of 16 years in Italy, Mr Allan returned to Scotland, and was appointed master of the academy for drawing and painting established in Edinburgh by the Trustees for Manufactures, &c. Beside the ordinary duties of his situation, the illustrations of the popular pastoral, the Gentle Shepherd, the Scottish Wedding, the Highland Dance, the Repentance Stool, and the Cottar's Saturday Night, from the poem of our immortal bard Burns, are enumerated among the admired productions of his pencil; and those who are acquainted with Scottish manners can fully appreciate the characteristic touches and delicate humour which abound in those pictures. The Prodigal Son, in the possession of Lord Cathcart, and Hercules and Omphale, in the possession of Mr Erskine of Mar, are also favourable specimens of his professional talents. The private character of Mr Allan, which was distinguished by amiable and unaffected manners, procured him the respect and attachment of his friends while he lived, and their unfeigned regret followed him to the grave, in August 1776, in the 53d year of his age.

ALLANTOIS, a membrane which invests the fœtus of quadrupeds, is of a thin structure, and lies between the amnios and chorion.

ALLEGHANY MOUNTAINS, sometimes denominated *Appallachian* from a tribe of Indians occupying the banks of the Appalachicola river, is an extensive elevated ridge intermediate between the Atlantic ocean on the one hand, and the Mississippi and the lakes of North America on the other. This mountainous range, stretching south-west and north-east, commences in Georgia, runs through Virginia and Pennsylvania, and terminates in New Brunswick. The whole length of the chain is stated at 900 miles, and the breadth, including the different ridges, varies from 70 to 150 miles. The greatest elevation, about 8000 feet above the level of the sea, is in New Hampshire. The sources of different rivers, some of which terminate in the gulph of Mexico, and others run into the Atlantic ocean, are traced to the Alleghany mountains.

The geological constitution of the Alleghany mountains affords examples both of the primary and secondary strata of rocks; granite, gneiss, micaceous, and argillaceous schistus, occupy the central and usually the more elevated parts of the chain; sandstone, limestone, with animal remains, and gypsum, are the prevailing rocks in the lower ranges; and extensive alluvial depositions have been formed in the vallies and flat country. The slaty strata are occasionally the respositories of silver, copper, and lead.

ALLEGHANY *County*, forms the western division of Maryland in North America, and is bounded by Pennsylvania on the north, by the river Potomack and Virginia on the south; contains a population of nearly 9000, and the chief town is Cumberland. Alleghany is also a county in Pennsylvania, the population of which exceeds 10,000, and Pittsburgh is the chief town.

ALLEGHANY *River*, rises from the west side of the Alleghany mountains, and after a course of 200 miles joins the Monongahela at Pittsburgh, and their united streams form the Ohio.

ALLEGIANCE, derived from a word which signifies *to bind*, denotes the legal tie by which the subject is bound to his sovereign or liege lord. The name and the form of this obligation are derived from our Gothic ancestors; but the nature of government, or the mutual connexion which subsists between the ruler and the ruled, or the king and his subjects, implies such an obligation. Under the feudal system, every owner of lands held them immediately of the sovereign himself, or of his vassals; and hence a mutual confidence arose between the lord and the vassal, that the lord or superior on the one hand should protect his subject or vassal in the enjoyment of his property, and that the vassal should be faithful to his lord, and defend him against his enemies. The obligation on the part of the vassal was expressed or acknowledged in the oath of fealty, which was required by the feudal law to be taken by all tenants to their sovereign or superior lord.

Allegiance, both expressed and implied, is distinguished by the law into *natural* and *local*. Natural allegiance is due from all men born within the king's dominions, immediately upon their birth, for then they come under the king's protection. Local allegiance is due from an alien, or stranger born, as long as he continues under the king's dominion and protection. Natural allegiance is regarded as a perpetual obligation, but local allegiance is only temporary. The oath of allegiance is in the following terms: "I, A. B. do sincerely promise and swear, that I will be faithful, and bear true allegiance to his Majesty King George," and may be tendered to all persons above 12 years of age, whether natives or foreigners, in the sheriff's court, or in the court leet of the manor; but the simple declaration of Quakers is admitted as a substitute for the formality of the oath.

ALLEGORY, is a figurative mode of writing, which consists in selecting a secondary subject, in which the chief circumstances bear some resemblance to the principal subject, and thus contributes to its illustration. Allegorical writing has been not unaptly compared to emblematical painting, in which an exercise of the mind, by reflection and meditation, to discover the meaning and application, is required; and in this way instruction and amusement are combined. The 80th psalm, in which a vineyard is made to represent God's own people the Jews, has been often quoted as an example of a beautiful and correct allegory. The address of Nathan to David, in 2 Sam. chap. xii. is another excellent illustration of allegorical composition.

The progress of human life is finely represented in an allegory, under the figure of a voyage, in the following beautiful verses by our celebrated poet Cowper.

Thou, as a gallant bark from Albion's coast,
(The storms all weather'd, and the ocean cross'd)
Shoots into port at some well-haven'd isle,
Where spices breathe, and brighter seasons smile;
There sits quiescent on the floods that show
Her beauteous form reflected clear below,
While airs, impregnated with incense, play
Around her, fanning light her streamers gay;
So thou, with sails how swift! hast reach'd the shore,
"Where tempests never beat nor billows roar."
And thy lov'd consort on the dang'rous tide
Of life, long since, has anchor'd at thy side.
But me, scarce hoping to attain that rest,
Always from port withheld, always distrest—

Me howling winds drive devious, tempest-toss'd,
Sails ripp'd, seams opening wide, and compass lost;
And day by day some current's thwarting force,
Sets me more distant from a prosperous course.

ALLEGRI, Antonio, designated Corregio, from the place of his birth, an eminent painter, was born in 1494; and merely by the force of his own genius, unaided by wealth or patronage, acquired that lasting fame which his own age denied, but which posterity has amply awarded. The scantiness of his means precluded him from visiting Rome. Parma was the chief place of his residence, where he was employed to paint the cupola of the cathedral. The subject is the assumption of the Virgin; and when it was finished, the canons, through ignorance or avarice, found fault with the work, and paid him only 200 livres, a smaller sum than the stipulated price of his labour. This harsh and unfair treatment threw him into a fever, which in three days terminated his life and misfortunes, in 1534, and in the 40th year of his age. The admiration and applause of Annibal Caracci, who flourished 50 years after Corregio, afford the most undoubted testimony of the excellence of his productions. "Every thing I see here," he says, "astonishes me, particularly the colouring and beauty of the children. They live, they breathe." And the magnificent painting on the cupola of the cathedral was admired by the celebrated Titian, to whom, indeed, its preservation is ascribed; for so little was the merit of the performance understood, that the canons expressed to him their intention of having the whole defaced. With some degree of vanity, he replied, "Take care what you do; if I were not Titian, I would certainly wish to be Corregio."

ALLEGRI, Gregorio, a celebrated composer of music, and chiefly of church-music, flourished in the 17th century, was a native of Rome; was appointed, in 1629, one of the singers of the Pope's chapel, and became eminent by the simplicity and purity of the harmony of the church services which he composed. His most distinguished production is the *Miserere*, which continues to be annually performed in the pontifical chapel, on Wednesday and Good Friday in passion week, by the choral band and the principal singers of Italy. But the solemnity of the ceremonies observed during the performance, it is justly supposed, adds not a little to the impressive grandeur of the whole. "The pope and conclave are all prostrated on the ground; the candles of the chapel, and the torches of the ballustrade, are extinguished one by one, and the last verse of the psalm is terminated by two choirs; the master of the chapel beating time slower and slower, and the singers diminishing, or rather extinguishing the harmony by little and little to a perfect point." The private character of Allegri was amiable and excellent. The poor were bountifully relieved by his charity, and the prisoners derived comfort from his kindness and beneficence in his daily visits to their dreary abodes. He died in 1652.

ALLEGRO, a musical term, denoting that the part which is thus marked is to be performed in a brisk and gay manner.

ALLEIN, Joseph, a nonconformist divine, was a native of Wiltshire, was born in 1633, educated at Oxford, and was settled, in 1655, in Taunton Magdalen, in Somersetshire; but, on account of his principles, was deprived of his living. He died in 1688, at the early age of 35. One of his religious works, entitled *Alarm to unconverted Sinners*, had an extraordinary circulation. Twenty thousand copies of an edition published in 1672 were sold; three years afterwards, in 1675, the almost incredible number of 50,000 were disposed of under the title of *A Sure Guide to Heaven*, and a large impression with the original title in 1720.

ALLEYN, Edward, a celebrated English actor in the reigns of Elizabeth and James her successor, and founder of Dulwich college in Surrey, was born in London in 1566. He was the cotemporary of Shakespeare, an original actor in some of his plays, and seems to have lived on the most friendly habits with the poet, as well as with Ben Johnson. Alleyn amassed a large fortune by his profession, in which he rose to considerable eminence. In the quaint language of one of his biographers, he is described as a "Proteus for shapes, and a Roscius for a tongue." But it was not solely to his own individual dramatic efforts that he was indebted for the wealth which he accumulated. He was manager and proprietor of a theatre which he built at his own expense; and he derived an annual revenue of L. 500 from the place of keeper of the king's wild beasts, or master of the royal bear garden. The buildings of Dulwich college, begun in 1613, under the superintendence of the celebrated architect Inigo Jones, were finished in three years, at an expense of L.10,000, and lands to the amount of L.800 a-year were appropriated for the support of the institution, which was destined for the maintenance of a master and warden, who were always to be of his name, and four fellows, three of whom must be clergymen, and the fourth a skilful organist, beside six poor men, an equal number of women, and 12 poor boys, who were to be educated till the age of 14 or 16, and then placed in some trade. It is a curious fact in the history of this institution, that the charter for the appropriation of the lands intended for its support was for some time retarded by lord chancellor Bacon, who wisely recommended to the king to devote part of the funds to the establishment of two academical lectures; and it was not till 1619 that the royal licence was obtained, and publicly announced in the new chapel of the college, which is denominated the *College of God's Gift*; and it is not less curious that the founder became the first master, and submitted to the economical arrangement which he had formed for the institution. But while he restricted his enjoyments, he was not unmindful of worldly affairs; for he still continued in the lucrative management of the theatre; and, besides this college, which continues to flourish, he made suitable provision for the support of several alms-houses in London and Southwark.

The following letter, which appeared in the Annual Register for 1770, contains a singular anecdote of Alleyn and his dramatic friends, who used to spend their evenings at the sign of the Globe, near Blackfriars, and in the vicinity of the play-house. It is addressed to a friend by G. Peele, a fellow of Christ Church college, Oxford, and a dramatic writer, who was a member of the club.

"Friend Marle,—I never longed for thy company more than last night: we were all very merry at the Globe, when Ned Alleyn did not scruple to affyrme pleasantely to thy friende Will, that he had stolen his speech about the qualityes of an actor's excellencye in Hamlet his tradgedye, from conversations manyfold whych had passed betweene them, and opinyons given by Alleyn touchinge the subjecte. Shakespeare did not take this talke in good sorte; but Johnson put an ende to the strife with wittylye remarkinge, *This affaire needeth no contentione; you stole it from Ned, no doubt; do not marvel: Have you not seen him act tymes out of number?* Yours, G. Peele."

Alleyn died in 1626, in the 61st year of his age, and was buried in the chapel of his own college, where a tombstone, with an inscription, marks his grave. The original Diary of this remarkable character, it is said, is still preserved in the college.

ALLIA, a river of Italy, whose stream joins the Tiber, four miles from Rome. The Romans sustained a dreadful disaster on the banks of this river, when an army of 40,000 was either slain or put to flight by the Gauls under Brennus; and hence it is remarked by Cicero, that their ancestors deemed the battle of Allia a more fatal event than that of taking the city.

ALLIANCE, is a relation contracted between two persons or families by marriage; but, in a political sense, it denotes an obligation entered into by sovereigns or states for their mutual safety and protection. *Offensive* alliance is when the contracting parties bind themselves to make war upon the common enemy; and *defensive* alliance when they assist each other to repel his attacks.

ALLIER, a department of France, formerly the province of Bourbonnois, derives its name from the river which traverses it from north to south; has the department of the Loire on the east, contains nearly a million and a half of square acres, and about 270,000 inhabitants; includes some extensive forests, and is celebrated for its mineral waters at Vichy and Bourbon, places of great resort in spring and autumn. The fish taken in the lakes and marshes of this department form a considerable branch of trade.

ALLIGATION is an arithmetical operation, by which questions which relate to the mixture of one ingredient with another of different weight and value are solved. See ARITHMETIC.

ALLIGATOR, the specific name of the American crocodile, derived from the Spanish word which signifies a lizard. See *Lacerta*, under ERPETOLOGY.

ALLIONIA, a genus of plants belonging to the Tetrandria class.

ALLITERATION is the repetition of the same letter at the beginning of words or syllables at certain intervals; it is chiefly, although not exclusively, employed in poetical compositions, and is considered by some as an ornament of language, while others regard it as a trifling and false refinement. Some critics ascribe the pleasure derived from alliteration to a mechanical operation, or to the facility of articulating similar sounds; and others conceive that it is to be traced solely to the gratification of the ear derived from the frequent recurrence of the same sounds. Perhaps, if rightly investigated, the effects of alliteration depend on the operation of both causes. Alliteration is in frequent use with the best English poets. In the following examples the alliterative letters are in italics.

*B*ehemoth *b*iggest *b*orn.—MILTON.

*S*oftly, *s*weet, in Lydian measures,
*S*oon he *s*ooth'd the *s*oul to pleasures.—DRYDEN.

Eternal beauties grace the *s*hining *s*cene,
*F*ields ever *f*resh, and *g*roves for ever *g*reen.—POPE.

*R*uin seize thee, *r*uthless king.—GRAY.

That hush'd in grim re*p*ose ex*p*ects his evening *p*rey.—IBID.

Nor cast one *l*onging, *l*ingering *l*ook behind.—IBID.

ALLIUM, a genus of plants, including the onion, leek, and garlic, and belonging to the Hexandria class.

ALLOA, a sea-port town on the north side of the Frith of Forth, and in the county of Clackmannan, in Scotland, has been long a place of some note in Scottish history. The massy tower in the vicinity, which is 90 feet high, was erected about the end of the 13th century, and seems to have been at one period a royal residence; for, in 1365, the lands and tower of Alloa were exchanged by David II. king of Scotland, with Thomas Lord Erskine, and has since continued to be the residence of the family of Marr, who were long guardians of the princes of Scotland. The cradle of Henry prince of Wales, the last heir of the Scottish monarchy, and the child's chair of James VI. are still preserved in the tower. The pleasure-grounds of this ancient residence were laid out in the French style in the beginning of the 18th century.

The harbour of Alloa is safe and commodious, and has the advantage of a dry dock, capable of admitting large vessels. The manufacture of common glass bottles is extensive; but the coal mines, some of which have been wrought for nearly 200 years, and the distilleries in the neighbourhood, are the chief sources of the trade of Alloa. Thirty-five thousand tons of coals have been exported in the course of a year; and in 1806, more than 1,000,000 gallons of whiskey were shipped. The chief imports are grain, limestone, ironstone, and wood and iron from the Baltic. The population of Alloa is about 3000, and the distance from Leith is about 20 miles.

ALLODIAL is applied to lands which are held by a person in his own right, without any service or acknowledgment to a superior.

ALLOY is the combination of two or more metals, by which the properties of the individual metals are changed, and new properties, which render the compound extremely valuable in the arts, are obtained. Alloy is also employed to signify the proportion of a baser metal, which is mixed with gold and silver, for the purpose of coin. In the gold coin of this country, silver and copper are used as the alloy, and it is estimated by carats. Standard gold contains 2 carats of alloy, and 22 carats of fine gold. Copper alone is the alloy of the silver coin; and standard silver contains 18 dwts. of copper alloy, and 11 oz. 2 dwts. of fine silver.

ALLUVION, denotes the gradual increase of land on the banks of rivers, or on the sea-shore. When the addition has been effected slowly and imperceptibly, the land thus obtained belongs to the proprietor of the ground to which the addition is made; but, in case of sudden and violent changes, as by a convulsion of nature, or the alteration of the course of a river, the separated land belongs to the original proprietor.

ALMACARRAN, a sea-port town in the province of Murcia in Spain, in the neighbourhood of which is found a red ochre, which is employed in painting, and as an ingredient in Spanish snuff. The rocks in the vicinity afford abundance of aluminous ore. It is 20 miles west of Carthagena.

ALMADEN, a town of La Mancha in Spain, which has been long celebrated for its quick-silver mines, which began to be wrought by Germans before the middle of the 17th century. The ore is cinnabar, or native vermilion; and twelve furnaces, which are whimsically called the twelve apostles, are employed in refining it. Almaden contains above 300 houses, and the inhabitants are chiefly occupied in the mining establishment. Almaden is 44 miles north from Cordova.

ALMAGEST, is particularly applied to a work which is ascribed to Ptolemy, and which contains various problems in Geometry, and observations on astronomy, and a catalogue of the fixed stars. This collection was found at Alexandria, and was translated by the orders of Almamon into Arabic, in 827; and the original Greek text, which was discovered at Constantinople, has been translated into Latin. The same title has been used by others, as in a book of astronomy by Riccioli, which is called the *New Almagest.*

ALMAMON, a distinguished caliph of Bagdad, and a celebrated astronomer, was born in the year 786. His reign was disturbed by those insurrections and rebellions which were common in the countries over which he ruled. His name is chiefly worthy of being transmitted to posterity as the liberal patron of literature and science. In early life, and before he ascended the throne, he established an academy, and invited the learned men of different nations to his territories to become the teachers of youth. Unshackled by the prejudices of the times, he placed a Christian physician from Damascus at the head of his institution. Astronomy was cultivated in the time of his grandfather Almansor, who was the second caliph of the Abassides; Almamon continued to encourage and promote the same study, and was himself no mean proficient in that sublime science. The obliquity of the ecliptic was observed in his time, and the geometers whom he liberally supported were employed in the measurement of a degree of the meridian on the plains of Mesopotamia. To facilitate the more rapid and extensive diffusion of knowledge, the best works on various subjects were translated from different languages. This wise and liberal sovereign, having reigned more than 20 years, died in the 49th year of his age.

ALMANACK, from the Arabic words *al* and *manack*, which signify *the Diary*, is a book or table containing a kalendar of days and months, rising and setting of the sun, age of the moon, eclipses, &c. As the construction of tables of this description depends on astronomical observation, almanacks are supposed to have been first drawn up by the Arabians, among whom astronomy flourished. Regiomontanus, the astronomer, reduced almanacks to their present form and arrangement in Europe. His first almanack was published in 1471.

ALME, or ALMEH, a class of women who have devoted themselves to the practice of singing, recitation, and dancing, in Egypt and other eastern countries, and are accustomed to extemporaneous poetical effusions, on subjects of immediate occurrence. The Almé of Egypt form a celebrated profession to which those only who are properly qualified are admitted. For this purpose, beside being carefully instructed in the arts of singing and dancing, they must possess an accurate knowledge of the language, and acquire a facility of composing verses without premeditation.

The Almé form a part of all festive entertainments, and they are employed as fictitious mourners at funeral solemnities: Different orders of the Almé are found who accommodate their performance to the rank of society before whom they exhibit. The higher orders are well educated, and of a polished character; but those whose exhibition is confined to the lower ranks of the people, are little distinguished by correctness of conduct or delicacy of manners; and there are probably few or none of the whole profession that are entirely free from the charge of some degree of licentiousness. Among the Hindoos, the Almé are divided into three classes; the first is devoted to the service of the temples, where dancing is occasionally introduced; the second is called the fashionable class, who are descended from the *cast* or tribe of weavers, whose females have been long destined to this profession; and the third, or lowest class, is composed of women of very inferior accomplishments, and equally indifferent morals.

ALMOHEDES. See Almoravides.

ALMONER, an officer in religious houses, to whom were entrusted the management and distribution of alms to the poor. According to ancient canons, a tenth part of the revenue of monasteries ought to be destined to charitable purposes. The Lord High Almoner of England is an ecclesiastical officer, and usually a bishop, into whose possession all deodands, and the confiscated goods of suicides, fall, for the purpose of being distributed to the poor; and to the same officer, by ancient custom, belongs the power of giving the first dish from the king's table to any poor person he chuses, or in lieu of it a sum of money.

ALMORAVIDES, an Arabic tribe, who retired to a secluded district of Africa for the purpose of observing more rigidly the peculiar precepts of the Koran. They assumed the name of Morabites, which was converted by the Spaniards into that of Almoravides. Abubeker Ben Omar was the first chief, and with the aid of an insurgent army from Numidia and Libya he founded the dynasty in 1051. His son and successor, Joseph, subdued and became master of Morocco, Tunis, and the intermediate territory, crossed the Mediterranean, and reduced many of the kingdoms of Spain to subjection; and in a second invasion in 1107 penetrated into Portugal, as far as Lisbon. Ali his son, who succeeded in 1110, more disposed to cultivate the arts of peace, planned and erected the great mosque of Morocco, and many other public edifices. He was slain in a dreadful battle with Alphonso king of Arragon; and his son, after a luxurious and oppressive reign of 25 years, was driven from his throne, and succeeded by a new dynasty, known in history by the name of Almohedes.

The founder of the dynasty of the Almohedes was Al Mohedi or Mohedes, a Berebber, or native of the mountains, who appeared as a preacher or reformer, and became leader of the orthodox or Unitarians. A clamorous advocate for liberty, and professing unbounded zeal for religion, he soon attracted notice, and formed a party, whose views, as their numbers increased, extended to other objects beside the purity of the faith. A public attempt to suppress them was made by Brahem, the last of the race of the Almoravides; but it proved unsuccessful; he was driven from his capital, pursued as a fugitive, with his favourite wife on horseback behind him, and despairing of escape from his enemies, threw himself over a precipice, where he and his wife were dashed to pieces.

The termination of the dynasty of the Almoravides, was the commencement of that of the Almohedes, of whom the first king was Abdolmumen, a powerful leader of the new party. The constitution of their government was wisely framed to insure popularity; the civil and religious establishments were united in a council of 40 persons, and the sovereign, who was both king and chief priest, was chosen from that number. This dynasty, which continued for 170 years, neglected not the security or extension of their temporal power by means of the sword, both in Africa and Spain. But a disastrous battle with the Christians in the latter country, in which nearly 200,000 Moors fell on the field, weakened the attachments of his native subjects to Al Nahör, the last but one of this race, and in a short time occasioned his death. The assassination of his successor and grandson was the termination of the dynasty.

ALNWICK, the county town of Northumberland, in England, like other border towns, was formerly surrounded with walls, which the fortunate cessation of intestine war has permitted to fall to decay. One of the gates, in the form of a tower, still remains as a memorial of the gallant Hotspur, by whom it was erected. Alnwick is situated on the river Alne, from which the name is derived, contains a spacious square for the public markets and public buildings, and from which the principal streets proceed. The population is nearly 5000; no manufactures of any extent or importance have been established in Alnwick, and its inland situation affords few facilities to trade; but every branch of liberal education is taught in three free schools, which are supported by the public revenue of the town.

The castle, the seat of the chief of the Percy family, and one of the grandest baronial residences in the kingdom, with its extensive and beautiful grounds, forms one of the principal ornaments to the vicinity of Alnwick. This gothic structure has been of late years completely repaired, and the internal decorations have been finished with great elegance and splendour. The chapel, with its painted and gilt mouldings, and stucco work, and fine specimens of painted glass, is much admired. During the residence of the Duke of Northumberland at this princely mansion, the style of old English hospitality is kept up. On certain days the gentlemen of the surrounding districts, and even respectable strangers, are admitted by a kind of tacit general invitation to the table of this noble family.

Alnwick is 84 miles south from Edinburgh, and 310 north from London.

ALOPECURUS, Fox-tail Grass, a genus of plants belonging to the Triandria class, of which several species are natives of Britain, and are cultivated as pasture-grasses.

ALPHABET, a word derived from the names of the first and second letters of the Greek alphabet, denotes the order or series of the letters of any language. See LANGUAGE.

ALPINI, PROSPERO, in Latin, *Prosper Alpinus*, a celebrated physician and naturalist, was a native of the Venetian republic, and was born in 1553; spent part of his early years in the military profession, afterwards studied medicine at the university of Padua, and settled at a small town in the Paduan territory. With a strong inclination for botanical pursuits, he eagerly embraced the opportunity of accompanying the Venetian consul to Egypt, where a residence of three years enabled him to extend his knowledge of plants and of vegetable economy. From observations which he made on the management of date palm-trees in that country, it appears that he deduced the doctrine of the sexual difference of plants, which was assumed as the foundation of the Linnæan system.

Alpini returned to Venice in 1586, was appointed physician to Andrew Doria, prince of Melfi, and at Genoa, where he resided, acquired the reputation of the first physician of the age. But the Venetians, it is said, were jealous that strangers should enjoy the benefits of the professional abilities and reflected fame of their countryman, and recalled him, in the year 1593, to fill the botanical chair in the university of Padua, the duties of which he zealously and faithfully performed. He died in 1617, and was succeeded by his son. Alpini was a voluminous author: He wrote on Medicine in General; on the Practice of Medicine among the Egyptians; on the Plants of Egypt; on Exotic Plants, &c.

ALPS, originally restricted to that range of mountains which separates Italy from France and Germany, may be now considered as a general appellation of highly elevated land; and hence some ancient authors speak of *Spanish Alps*, and among the moderns any mountainous region is so denominated, as *Swiss Alps*, to which the term seems to have been first applied, *Asiatic Alps, American Alps, British and Scottish Alps;* and the phrases *Alpine country* and *Alpine plants*, are quite familiar to naturalists. The word is derived by some from the Latin word *albus*, white, a characteristic expression of their snow-capped summits, and by others it is traced to a Celtic origin, and signifies mountainous pastures, or *highly elevated land*. But the particular description of these mountainous regions falls more properly under the different countries to which they belong.

ALPS, three departments of France, in the immediate vicinity of the mountains from which the name is taken. In the Higher Alps, the rearing of sheep and cattle is the chief occupation of the inhabitants; in the Lower Alps the cultivation of potatoes is very extensive; and the Maritime Alps was an annexation, in 1793, of Nice and the principality of Monaco to France.

ALPUXARRAS, or ALPAXARES, the ancient *Montes Solis*, or Mountains of the Sun, a range of high mountains in the province of Granada in Spain, which occupy a space of 35 miles in length and 15 in breadth, from the city of Velez to Almeria. This elevated region is chiefly inhabited by the Moors who remained after the expulsion of their countrymen from Europe, and, preserving their own manners and language, have embraced Christianity. They are represented as skilful husbandmen, and are very successful in the culture of fruit trees. Among the natural wonders of these mountains are recorded the waters of a spring, probably of a chalybeate quality, which in an instant dye silk or linen, and the exhalations of a cavern, no doubt fixed air or carbonic acid gas, which are noxious to animal life.

ALSACE, a former province of France, now divided into the departments of the Higher and Lower Rhine, is one of the most fertile districts of the kingdom. The lower regions abound in corn, wine, and fruits; and the mountains are clothed with extensive forests.

ALSEN, a Danish island lying in the Lesser Belt, at the entrance of the Baltic, and between the island of Funen and the coast of Sleswick, from which it is separated by a narrow channel. Alsen is 20 miles in length and 10 in breadth. The soil is fertile, and produces grain, fruits, and a great deal of aniseed. The woods abound with game, and the lakes with fish. It is 100 miles west from Copenhagen.

ALSINE, Chickweed, now arranged by Dr Smith under the genus Stellaria, belonging to the class Decandria, was formerly placed as a distinct genus in the Pentendria class. Among the productions of the vegetable kingdom which are affected by changes of the weather, none, perhaps, affords a surer indication of a fair day than the full expansion of the flowers of chickweed in the morning.

ALSTON, CHARLES, a physician and botanist, was a native of the west of Scotland, and was born in 1683, commenced his studies at the university of Glasgow, and, under the patronage of the Duchess of Hamilton, attached himself exclusively to medicine, in the prosecution of which, in his 33d year, he accompanied the first Dr Monro to Leyden, where he continued three years, under the instruction of the celebrated Boerhaave. The return of Monro and Alston to their native country may be considered as a propitious era to the university of Edinburgh; for to them, in conjunction with Sinclair, Rutherford, and Plummer, the origin of its medical school is to be traced. Dr Alston taught Botany and Materia Medica, and rendered himself conspicuous by combating the Linnæan doctrine of the sexual system of plants, in a memoir published in the Edinburgh Physical and Literary Essays. The language he employs in this memoir has not escaped censure, and perhaps merits it. He recommended the use of tin, powdered or granulated, for the expulsion of worms, in another memoir; he entered into a controversial discussion, concerning the properties and effects of quicklime, with Dr Whytt of the same university, and his lectures on Materia Medica were published in two volumes, 4to., ten years after his death, which happened in November 1760, and in the 77th year of his age.

ALSTON, or ALDSTONE MOOR, a town in the county of Cumberland, and in the hilly country on the borders of Northumberland, containing a population of nearly 4000, who are chiefly employed in the lead mines in the vicinity, which have been long celebrated for the abundance of that metal. The lands form part of the forfeited estates of the Earl of Derwentwater, and are held in lease for 1000 years from the governors of Greenwich hospital, to which establishment they were appropriated by the legislature. Alston Moor is 19 miles from Penrith, and 304 north from London.

ALSTONIA, a genus of plants belonging to the Polyandria class.

ALSTROEMERIA, a genus of plants belonging to the Hexandria class.

ALT, a term applied to the high notes in the musical scale, or those between F in the treble cliff note and G in altissimo.

ALTAI, or ALTAY, a range of mountains in the northern regions of Asia, which extend 5000 miles from the 70th to the 140th degree of E. longitude, form the boundary between the Russian territory and Chinese Tartary, and are divided, according to diversity of course or elevation, into the greater and lesser. But beside this general division, numerous branches stretch out in various directions. Some of these mountains are of such a height as to be covered with perpetual snow. They are chiefly composed of primitive rocks. Granite occupies the loftiest part of the range; the slaty rocks, as gneiss and schistus, are found in the intermediate division; and strata of limestone and marble are deposited in the lower regions. The Altaian mountains are the copious repositories of various metallic ores, as gold, silver, copper, lead, and iron, and some of them have been extensively wrought, of which some notion may be formed from the number of persons, exceeding 50,000, employed in the different operations.

ALTAR, a structure on which sacrifices were offered to some deity, was made of various forms and materials. Altars are supposed to be coeval with sacrifices themselves. While some date the origin of altars in the time of Adam, others think that Enoch was the first who consecrated a public altar; but the earliest testimony concerning altars referred to those erected by Abraham. Of the simplicity and rude form of altars in the patriarchal times, what is recorded in Scripture of the stone which had served Jacob for a pillow, and which he set up in Bethel, furnishes a striking example.

Among the ancients, the word *ara*, in its more general signification, included every kind of altar. But a distinction is sometimes made by some authors, and perhaps was actually observed in their ancient modes of worship. The altar properly called *ara*, was not elevated above the surface of the ground, and it was devoted to the service of the terrestrial gods; the altars dedicated to the celestial gods were raised to some height, and were thus denominated *altaria* from *alta* and *ara*, or *high altar*; but holes were dug into the earth, called *scrobiculi*, when altars were set apart for the worship of the infernal gods. Altars were adorned with sculpture, representing the figure of the deity to whom they were erected, or some appropriate symbols. A Bacchanal, with a thyrsus in his hand, is the characteristic of the altar of Bacchus; and the figure of Neptune, with the pallium on his shoulder, a trident in his left hand and a dolphin in his right, or a genius with an oar on his neck, clearly indicates the altar which is thus decorated to belong to the sea god. Groves, highways, the tops of mountains, and other conspicuous places, were chosen for the erection of altars.

The altars of *incense*, of *burnt-offerings*, and of *shew-bread*, which were the principal altars among the Jews, were made of shittim-wood; the first and the last were covered with plates of gold, and the second for the burnt-offerings was covered with brass. The Jewish, as well as the heathen altars, afforded an asylum, or place of refuge to such as fled from violence, and even to such as were guilty of crimes, from a notion probably that they were under the protection of the deity to whom the place was dedicated. A similar privilege, it is well known, has been extended in some ages to Christian churches. Solemn transactions, as the administration of oaths, alliances entered into between different nations and individuals, and the confirmation of treaties of peace, have been often ratified and concluded at altars.

ALTDORF, or ALTORF, the capital of the canton of Uri in Switzerland; a fine town, which stands near the lake of the Four Cantons, in a plain surrounded with lofty mountains clothed with wood; contains a population of 4000; is famous as the birth-place of the celebrated William Tell, the intrepid champion of Swiss liberty; and is 20 miles S. E. from Lucerne, and 33 miles S. from Zurich.

ALTENA, see ALTONA.

ALTHEA, Marshmallows, a genus of plants belong to the Monadelphia class.

ALTIN, or ALTYN, a lake of Siberia, which is situated on the elevated country on the north side of the Altaian mountains; is estimated at 90 miles in length and 30 in breadth; the southern extremity never freezes, but the northern division admits of travelling on foot across it in the winter; it is subject to inundations in summer from the melting of the snows, and it is one of the sources of the great river Oby.

ALTITUDE, or Height, is an astronomical term applied to the heavenly bodies, and expressive of their position above the horizon, as the altitude of the sun, of the moon, or of a star.

ALTONA, a city of Holstein, belonging to Denmark, is situated on the north bank of the Elbe, and is the sea-port of the Danish East India Company; is of some commercial importance; has the conveniency of docks for ship-building; and many of the inhabitants, which amount to 25,000, are actively employed in various manufactures. Altona is two miles west from Hamburgh.

ALUM, an earthy triple salt, composed of sulphuric acid, alumina, or pure clay, and an alkali, usually potash, or a compound of sulphate of alumina and sulphate of potash. For its chemical properties, see CHEMISTRY; and for an account of the manufacture of alum, see SALTS, under which will be detailed the history and processes for the preparation of the various saline substances employed in the arts.

ALYSSUM, Madwort, a genus of plants belonging to the Tetradynamia class, some of the species of which were supposed to have the property of curing madness.

AMADAN, or HAMADAN, one of the chief towns of a province of Persia, is finely situated on a spot between Taurus and Ispahan, and on the road from Mecca to the northern parts of Asia. The numerous springs in the vicinity, and the surrounding gardens, add greatly to the beauty of the place, the air of which is so salubrious as to render it the frequent resort of invalids in the spring; and from being occasionally the summer retirement of the Persian monarchs, it has obtained the designation of *royal city*. Among many splendid tombs which decorate Amadan, the mausoleum or tomb of the celebrated Arabian physician, Avicenna, still exists; and, according to a tradition of the Jews, the ashes of Esther and Mordecai repose in a tomb not far from their synagogue in this place, to which, it is said, devotees of that persuasion, from the country about the Levant, sometimes perform pilgrimage. Amadan, it has been supposed, is the ancient Ecbatana, was destroyed by Nebuchadnezer, and rebuilt by Darius. N. Lat. 35° 15′. E. Long. 48°.

AMAK, an island to the south of Copenhagen, about two miles in length and one mile in breadth, and containing about 3000 or 4000 inhabitants, in different villages, who are the descendants of a Dutch colony established in the beginning of the 16th century by a Danish queen, for the purpose of supplying Copenhagen with vegetables, butter, and cheese. The communication between the island and Copenhagen is facilitated by a draw-bridge. The whole island is under excellent cultivation, and is laid out in pastures and gardens. The inhabitants retain their original dress and manners; but intermarriage, and constant intercourse with the Danes, have corrupted their language, which is now a mixture of Danish and Low Dutch.

AMALEKITES, a powerful people of Arabia Petræa, are supposed by some to be the descendants of Amalek, the son of Eliphaz, and the grandson of Esau; but, according to the Arabian tradition, their descent is to be traced to Amalek, a grandson of Noah, and there were different tribes of the same

Amalfi.

name. The progress of the Israelites from Egypt to the promised land was greatly harassed by a warlike tribe of this people, in consequence, it is said, of an enmity still existing in remembrance of their progenitor, Esau, being deprived of his birth-right, and of his father's blessing, by the patriarch Jacob. They were attacked and completely routed by the Israelites under their leader Joshua. The same people, or a tribe under the same name, in conjunction with the Moabites and Midianites, renewed their hostile operations against the Jews in the time of the Judges; but their attacks were vigorously repelled by Gideon. Saul advanced to the capital of the Amalekites, and put the whole people to the sword; at a future period, a few scattered bands of the Amalekites who had escaped, pillaged Ziklag, which was the residence of the family of David, who pursued them, dispersed the plunderers, and recovered the booty; and from this time history is silent concerning them.

AMALFI, a sea-port town in Italy, is situated on the gulf of Salerno, is about 30 miles south from Naples, and dates its origin about the middle of the 4th century, when some families from Rome, proposing to emigrate to Constantinople, were driven by a storm to the shores of Salerno, and settled on the spot. The situation which chance fixed for their residence afforded peculiar advantages for commercial enterprise; and as the inhabitants increased in number and opulence, they were not inattentive to avail themselves of the facilities which it offered for carrying on a lucrative trade with the eastern parts of the world, with the productions and manufactures of which they supplied the countries to the west. About the middle of the ninth century, Amalfi rose to great splendour; assumed the form of a commonwealth; acquired the dignity of an archiepiscopal city; and, for its zealous exertions against the infidels, was distinguished by the title of *Defender of the Faith*. The population of the city was not less than 50,000; the whole trade of the Levant was under their management, and they had establishments in almost every country of the civilized world. The fortunate discovery of the mariners' compass has been ascribed to them, or to the native of a neighbouring village. To add to the dignity and importance of this enterprising people, an order of knighthood was established under the patronage of St John of Jerusalem. The members of this order became afterwards the knights of Rhodes, who were at last absorbed in the celebrated military order of the knights of Malta.

The prosperity of this small but rich commonwealth excited the jealousy of their poorer and more barbarous neighbours; and having repelled repeated attacks, they were entirely overwhelmed by the Normans, after having enjoyed their republican constitution and commercial rank for 300 years. From this time the wealth and power of Amalfi declined, and its lucrative trade was transferred to the Genoese and Venetians. The ruins of a cathedral, and of the splendid mansions of its ancient merchants, are the only traces of the former grandeur of Amalfi, and the diminished number of its inhabitants, now reduced to 4000, presents a sad contrast to the crowded population in the prosperous periods of its history; and its maritime concerns, once so important and extensive, have dwindled into the excursions of fishermen, who are chiefly distinguished for their poverty.

Amalgam || Amazonia.

AMALGAM is a compound of quicksilver and some other metal, varying in its nature and properties according to the metal with which the combination is formed, and the proportions of the quicksilver employed. When other metals are combined, the word alloy is applied to the compound obtained.

AMARANTHUS, or Flower-gentle, a genus of plants belonging to the Monoecia class.

AMARYLLIS, Lily Asphodel, a genus of plants belonging to the Hexandria class.

AMASIA, a large and populous town, the capital of a district of the same name in Natolia, in Asiatic Turkey, was the residence of the ancient kings of Cappadocia, and is worthy of notice as the birthplace of Strabo, the celebrated geographer. Amasia is placed among rugged mountains, and on the banks of a river which discharges its waters into the Black sea; some remains of its former magnificence still exist, and it is the residence of a governor, and of the eldest son of the Grand Signior, the expectant heir of the Ottoman throne. The bulk of the inhabitants are Christians, so that a single mosque only appears in Amasia. The province of Amasia abounds with fine fruits, and furnishes excellent wines. N. Lat. 40° 44′. E. Long. 36° 10′.

AMAUROSIS, or GUTTA SERENA, a disease of the eye, which is supposed to be some affection of the optic nerve. In this disease no external symptoms appear, excepting the insensibility of the eye to the action of light.

AMAZONIA, an extensive region of South America, is about 1400 miles in length and 900 in breadth, stretching from the equator to the 20th degree of south latitude, and bounded on the west by Peru, and by Brazil and the Atlantic ocean on the east. This country was discovered about the middle of the 16th century, by Francisco Orellana, who had accompanied Pizarro in his expedition to those parts of South America which lie to the eastward of the Andes. But he deserted his commander, and, with a vessel manned with 50 soldiers, reached the ocean after a perilous voyage of seven months. When he arrived in Spain the exaggerated account of his adventures astonished all Europe; and, among other marvellous parts of his narrative, he pretended that he had discovered nations so rich that the roofs of their houses were covered with pure gold, and a republic of women, who resembled in their manners the fabulous Amazons of antiquity; and hence the country which he had traversed, derived its name, and the river formerly called the Maragnon was converted into the river of the Amazons.

Amazonia, except near the banks of the river, is scarcely known to Europeans. Every attempt of the Spaniards to colonize it failed. The Portuguese have a few small settlements near the mouth of the river; but the native tribes, which are numerous, and in a state of original barbarity, remain in undisturbed possession of this wide region. The greater part of the country is flat, and during the rainy season, when the rivers are swelled, the redundant waters form lakes and morasses. All the tropical productions are abundant; but the climate, although the temperature be not excessive, is generally unhealthy.

AMAZONS RIVER, originally called the Maragnon, and now the Amazons, presents the most remarkable feature of the extensive region which it traverses, and indeed of the New World. It is distinguished by its magnitude, the length of its course, the number of its tributary streams, and the huge body of waters which it rolls to the ocean. Issuing from the lake Lauricocha, which is about 90 miles from Lima, it proceeds southward, and being joined by many rivers, some of which have flowed 500 or 600 miles, and are equal to the Danube or Nile, it turns to the eastward, and, after a winding course of between three and 4000 miles, falls into the Atlantic ocean, nearly under the equator. At its mouth, it is 150 miles broad; and the depth of the stream, at the distance of 1500 miles from the sea, is not less than 240 feet. The tides are perceptible 600 miles from its mouth, and the descent, in a course of 1860 miles, as it was observed by M. De la Condamine, who sailed down the river in 1743, is not more than 1020 feet, or 6⅗ feet in the mile.

AMAZONS, a fabulous nation of females, who are said to have possessed that part of Asia Minor which lies on the coasts of the Black sea, and from whose society all men were excluded. They were celebrated for their warlike exploits; and, to fit them for martial exercises, they subjected themselves to those laborious duties which usually fall to the lot of men; and to admit the free use of the bow and the javelin, they cut off the right breast, and hence the name, which signifies *without the breast*, according to the Greek etymology, is derived. The existence of such a nation seems to be seriously believed by many ancient historians; and even as late as the 17th century, learned disquisitions are not wanting to prove the same fact. Dr Bryant, in his elaborate investigation of ancient mythology, considers the nation described under the name of Amazons, to have been Cuthite colonies from Egypt and Syria, who established themselves in different regions, and thinks that the name is derived from the word *zon*, "sun," which was the object of their worship. This seems to be a more probable account of the Amazons than the current relations of historians, which, indeed, contain sufficient internal evidence to disprove the whole story.

AMBARVALIA, from the word signifying to *go round*, and *field*, was a festival of the ancient Romans, in which sacrifices were performed to Ceres, to obtain an abundant harvest. It was held in April and July, and was celebrated either by the master of a family privately, or as a public solemnity, in which latter case the priests appointed to this service officiated, and were attended by the people, crowned with oak leaves, and singing hymns to the goddess whose favour was invoked. A bull, a sow, and a sheep were conducted in solemn procession round the ploughed fields, and these victims were afterwards sacrificed on appropriate altars. This festival was also called *suovetaurilia*.

AMBASSADOR, a public minister sent from one sovereign power as his representative at the court of another. Ambassadors are either *ordinary*, or such as reside constantly at the court to which they are appointed; or *extraordinary*, or such as are dispatched on some special mission of importance, and when this is accomplished their powers cease. By the mutual understanding among nations who are in the relation of peace and amity with each other, or, according to the indefinite obligation of the law of nations, ambassadors enjoy peculiar privileges, among which may be mentioned freedom from arrest of their persons, and from attachment of their goods, and the same privilege is extended to the persons and goods of all those who are in their train. But for criminal acts, which fall under the denomination of treason or felony, they are subject to punishment as private aliens.

AMBER, a mineral substance, generally of a yellowish colour, and semi-transparent, is ranked among the *inflammables* in the classification of minerals. Amber is distinguished by the peculiar acid which it affords, and it is not less remarkable for its electric properties. It was the first substance in which those properties were observed, and hence the Greek word *electron*, signifying "amber," is the origin of the name *electricity*. See MINERALOGY.

AMBERGRIS, or GREY AMBER, is an ash-coloured and variegated inflammable substance, which gives out, when melted, a peculiar fragrant odour, for which it is highly valued, and extensively employed in all kinds of perfumery. The origin of ambergris was long uncertain; but it is now distinctly proved to be an animal production; for although it is found floating in different parts of the ocean, it has been frequently extracted from the intestines of a particular species of whale; and therefore the conclusion is sufficiently obvious, that it is a matter secreted by that animal, and is to be considered either as the cause or consequence of disease, since the whales which afforded the greatest quantity were observed to be in a lean and sickly state.

AMBIDEXTER, from the Latin words, signifying "both," and "right hand," is applied to a person who uses both hands with the same facility. By the law of the ancient Scythians, that warlike people were compelled to accustom themselves to the use of both hands alike; and Plato, in the regulations of his republic, recommends the same practice; the purpose of which, no doubt, is, in both cases, to render them more prompt and expert in martial exploits. The Grecian pikemen and the Roman gladiators were trained to the same exercise; and it is recorded in Scripture, that 700 men of the tribe of Gad were capable of fighting equally well with both hands. The superior facility of action, which is most generally possessed by the right hand, has been the subject of physiological investigation, and has been ascribed to a larger flow of blood to that arm; but whatever difference may be observed in the structure of the right and left hands, it seems probable that it depends more on the power of habit than on any other cause.

AMBOYNA, an island in the East Indies, includ-

Ambrose ‖ Ambrosia.

ed under the Molucca or Spice Islands. See Spice Islands for a connected account of the whole group.

AMBROSE, Isaac, a presbyterian clergyman, eminent for his learning and piety, was born about the year 1591; received a liberal education at Oxford; was appointed minister of a congregation at Preston, and afterwards removed to Garstang, in Lancashire, from which he was ejected in 1662 for non-conformity. He is represented by his biographers as "a man of substantial worth, eminent piety, and exemplary life." It was his usual practice to spend a month every year in a small hut in a sequestered spot in the middle of a wood, and, avoiding all intercourse with mankind, to devote himself entirely during the period of his retirement to spiritual contemplation. He died in 1664, at the age of 73. He was the author of "The First, Middle, and Last Things, viz. Regeneration, Sanctification, and Meditations on Life, Death, Judgment," &c. "Looking unto Jesus," and other works, some of which still retain a considerable share of popularity.

AMBROSE was the name of a deacon in the Christian church, who was converted by Origen, and flourished about the beginning of the third century. He was a person of wealth and high rank, and is said to have employed his influence and riches in promoting the study of sacred literature.

AMBROSE, St. who lived towards the end of the fourth century, was at first governor, and afterwards bishop of Milan, and was greatly distinguished by the sublimity of his sentiments and the eloquence of his language.

AMBROSIA, according to the Heathen mythology is the solid food of the gods, whose drink was called *nectar*. Ambrosia, which is derived from the Greek, and signifies something which is not mortal, was supposed to confer immortality on those who were admitted to the felicity of enjoying it.

Ambrosina ‖ Amercement

AMBROSIA, a genus of plants belonging to the Monoecia class.

AMBROSINA, a genus of plants belonging to the Gynandria class.

AMBROSIUS, Aurelianus, a celebrated general of the ancient Britons, was descended from a Roman family, and flourished in the latter part of the fifth and beginning of the sixth century. He was successful against the Saxons, and compelled them to retire from the western districts of Britain. Having assumed the sovereign power, he directed his attention to the internal arrangement of the affairs of the kingdom, ordered the churches to be repaired, and the public worship to be restored. The building of Stonehenge near Salisbury, a singular monument of mechanical power, which has long baffled the researches of the antiquary, is ascribed to Ambrosius; but in its erection, it is said, he was assisted by giants and magicians.

AMELLUS, Starwort, a genus of plants belonging to the Syngenesia class.

AMEND, or Amende, according to the practice of the French courts, is a pecuniary fine imposed by a judge for any crime, false prosecution, or groundless appeal.

AMENDE HONORABLE, a species of punishment formerly inflicted in France on traitors or parricides, when the offender was delivered into the hands of the executioner, his shirt was stripped off, a rope was put round his neck, and a taper in his hand, he was then led into court and required to beg pardon of God, the King, the court, and the country. The same term is also applied to a public recantation of an injury, made in court, and in presence of the person injured.

AMERCEMENT, or Amerciament, is a term in English law, and signifies a pecuniary fine imposed on offenders at the pleasure of the court, and without being regulated by any express statute.

AMERICA.

America.

America is the name of a large continent situate in the western hemisphere, from which circumstance it is sometimes called the Western Continent, and not unfrequently the *New World*, as having been but recently made known to the inhabitants of other parts of the globe. It is of immense extent, reaching from about the 54th degree of south latitude to a very high but hitherto unascertained northern latitude, and lying between the 35th and 136th degrees of longitude west from Greenwich. It is above 9000 English miles long, varying in breadth from 60 to 4000 miles. Equal to nearly one-third of the habitable earth, this great surface necessarily presents many differences of feature, as might be expected from the different climates through which it extends; but these diversities, it has been remarked, concur in one general expression of dissimilarity to any of the longer known continents. America is said to surpass them, for example, in the elevation and magnitude of its mountains, though some facts respecting Asia, lately discovered, make this particular doubtful; in the profusion and copiousness of its rivers, and the number and amplitude of its lakes; while its atmosphere scarcely recognizes those laws for the distribution of heat which are generally observed in other regions; and certain peculiarities in its animal and vegetable productions testify the independence and resources of that wisdom by which the common empire of nature is sustained. The usual division of this continent into North and South America, is pointed out by the striking circumstance of a connecting neck of land, about 1500 miles long, and narrower in some places than the isthmus which unites Africa with Asia, and by a diversity in the manners and language of the primitive inhabitants.

I. South America.

Like the opposite continent of Africa, South America is entirely surrounded by water, with the exception of a narrow point of land, which scarcely prevents the junction of two contiguous seas. Its extreme length,

South America.

which may be reckoned from Cape Vela, in about 12° north lat. to Cape Horn, in the island of Terra del Fuego, in 55° 58′ of south latitude, includes a distance of nearly 4000 geographical miles; and its greatest breadth, which seems to lie in the parallel of 5° south, is about 2880 miles. Some of its natural features merit particular notice.

Mountains.—The mountains of South America are extremely lofty, and of so great an extent as in some regions to form pretty considerable provinces. Thus, the Andes, a magnificent ridge, springing up near the southern extremity, and following the direction of the western coast, till it approach the Gulf of Darien in the north, afford space sufficient for the establishment of kingdoms, reckoning by the standard of European policy. It is in a summit of this ridge, called Chimborazo, near to the equator, that we find the astonishing elevation of 20,280 feet above the level of the sea, being 5000 feet higher than Mont Blanc in Switzerland, but much lower, it has lately been said, than a ridge in Asia. The plain of Quito itself, from which this summit rises, is higher than the top of the Pyrenees. About 25 miles to the S. E. of Quito is Cotopaxi, a volcanic mountain, upwards of 18,000 feet in height, reckoned in the same manner; and throughout this equatorial region are other summits of very extraordinary, though inferior elevation, as Cayamburo, Pinchincha, Sangay, the Altar, &c. The Andes branch out in various directions, and pervade a great part of this continent; but much of the interior, hitherto indeed but little explored, is conceived to form plains of an extent little less remarkable than the mountains with which they exhibit so important a contrast.

Rivers.—The magnitude of the rivers is in proportion to the grandeur of the mountains whence they issue. It is enough to mention the Maragnon, or river of the Amazons, the La Plata, and the Oronoco, some of the tributary streams of any of which would be reckoned immense in our part of the world. The natural history of these rivers is still very imperfect, and, judging from their size, complicated courses, and the number of their branches, will probably long remain so.

The general direction of the Maragnon, certainly the largest river in the world, is from west to east, between the equator and the 5th degree of south latitude, and the length of its course has been estimated at 3300 miles, including its windings. This is not so great a length, it is conjectured, as that of the Kian Ku, a river in China; but then in breadth and volume of water there is an astonishing superiority on the part of the former. The effect of the tides is said to be perceptible 600 miles from the mouth of the Maragnon. We may have some conception of the size of the river La Plata by this circumstance, that its banks are not discoverable from a vessel in the middle of its stream where it enters the ocean. But its depth is not proportioned to this width, although navigable above 1000 miles inland. The Oronoco is a very rapid and tortuous river, which often overflows its banks, and in consequence is liable to have its course much altered. It is to the north of the Maragnon, with some of the navigable branches of which it appears to be occasionally if not permanently connected. There can be little or no doubt, indeed, that, comparatively, a small degree of labour, properly bestowed, would effect a junction between most of the important subsidiary rivers in this region, and so render commercial intercourse more extensive than in any other country of the world. For this purpose, an adequate outlet, on the western coast, in subserviency to the chief branches of the Maragnon, is the only thing wanting.

Lakes.—As far as is yet known, South America has no lakes which are worthy of being compared with those found in the northern division. That of Parima, in the north-east quarter, has been described as 100 miles long and 50 broad. But the accounts respecting it are not much entitled to credit. It is supposed to give rise to several considerable rivers, and also to receive the chief stream of the Oronoco. Titicaca, which is near the middle of the western coast, and 100 miles from the ocean, is the most important lake in South America, and is about 240 miles in circumference, with a depth of water from 70 to 80 fathoms. In attempting to establish a communication with the Pacific ocean, so as to perfect inland navigation, this lake seems to offer advantages of the highest consequence.

Natural History.—The mineralogy of South America is exceedingly varied. All the classes of rocks, primitive as well as secondary, with their subordinate orders, exist in this extensive region. Volcanic products, besides, are scattered in great profusion, and most of the metals are found in abundance. On this part of South American natural history, the labours of Humboldt, a Prussian traveller, have lately contributed much curious information. A country occupying so many degrees of latitude, must present great differences of climate and seasons. In the extreme south, though by no means a very high latitude, there is almost perpetual winter. The seasons gradually become milder in approaching towards the north; and even under the equator, the heat, unless in some peculiarly confined situations, can scarcely be called excessive. In general, a difference may be allowed of about 20° degrees of latitude between this continent and the Old World, to admit corresponding degrees of temperature. Cold predominates in the New World, depending, no doubt, on the superior elevation of the land. Rain is frequent, and may be said to constitute the winter of some American countries, as dry weather does their summer. The seasons, of course, are the reverse of those which take place in the northern hemisphere.

1. Terra Magellanica, and Patagonia, are the names applied, with little propriety, perhaps, to that portion of this continent which reaches from the strait denominated after Magellan, a Portuguese navigator, who discovered it in 1519, to a line supposed to be drawn in the latitude of 45° south from the Pacific to the Atlantic ocean. It has been little frequented, and, excepting the coast, to which the attention of navigators has been often directed, is very imperfectly known. There are few temptations, indeed, to bring visitors to this region. Far removed from the theatre of commercial interests, and the arts which dignify social life, this inclement

South America.

country must probably long remain in the possession of its barbarous, but not inhospitable inhabitants, and present a mortifying picture to the benevolent philosopher. He will console himself, however, in the persuasion, which almost every one who has been personally acquainted with them, encourages, that contentment, the offspring of ignorance and insensibility, lessens the miseries of these wretched beings. But this consolation, unfortunately, must be somewhat modified by the fact, that an intercourse with the Spaniards towards the north, has subjected them to some of the evils of civilization, without its corresponding benefits.

Of all the tribes which are thinly scattered throughout this country, and denominated Moluches, Tehuels, Puelches, and Aucas, these last are conceived to be the most improved. They are said to have made some progress in agriculture, and to be able to manufacture garments of wool and cotton. The others, in general, subsist chiefly on animals taken in the chace, to which, also, they are indebted for their only coverings from the rigours of the climate.

The gigantic size of some of the people found in this region, has been so frequently and so respectably affirmed, that it is hazardous to attempt its denial. Some exaggeration, no doubt, may have occasionally taken place; but it may be confidently stated, that a stature which would be thought extraordinary in Europe, is not uncommon among the Patagonians.

The people of Patagonia are either altogether without religion, or are addicted to the worship of the sun and moon as the supreme sources of the scanty favours which they enjoy.

Horses, of which the Patagonians are expert riders, are rather plentiful amongst them since their intercourse with the Spaniards. They have also some sheep and cattle. Among the wild animals of this region, are the guanaco and armadillo.

In many respects, the island of Terra del Fuego, that is, Fiery Island, so named by Magellan, who observed volcanoes in its mountains, bears considerable resemblance to the land now spoken of. It lies to the south of the strait formerly mentioned, is of great extent, and, with several other islands in its neighbourhood, has been often visited by vessels destined for the South Pacific ocean. But it does not afford any circumstance of sufficient interest to occupy attention in this place.

2. Chili—denotes a country extending northwards above 1000 miles along the western coast, from the 45° S. Lat., and having a breadth varying from 300 to 500 miles. The name is that used by the natives, and is said by them to signify a bird whose appearance is reckoned auspicious.

This is a delightful region, possessing a temperate climate and a productive soil. The existence of several volcanoes in the mountains of the Andes, by which it is traversed, and the sparing occurrence of slight earthquakes, cannot materially lower the estimate we form of its advantages. It is singular, then, that a great part of this country should still remain unoccupied, either by native tribes or the Spaniards, the latter of whom have settled chiefly towards the sea-coast, on which they have built several towns; and the Araucans, by much the most important of the former, inhabit a fine tract, reaching from the river Valdivia to the river Biobio, bounded on the west by the ocean and on the east by the mountains already named. This people exhibit several noble qualities, which need only the fostering care of a liberal and judicious government to produce an excellent national character. But this benefit, even supposing the Spaniards capable of yielding it, would probably be resisted by a spirit of pride in themselves, which disdains alike to acknowledge an imperfection, and to be indebted to another for its removal.

South America.

That part of Chili which is inhabited by the Spaniards is divided into 18 districts, governed by a single chief, who has almost unlimited power in all the concerns of the province. The population may be estimated at upwards of 300,000, of which more than two-thirds are either negroes or a mixed race.

Trade.—Commerce has hitherto made small advancements in this country. The chief articles of barter are the precious metals, (by no means wrought to the full extent,) hides and leather, grain of different kinds, and fruits. The principal trade carried on is with the natives of the adjoining provinces. A communication with the East Indies, properly managed, would render Chili one of the most prosperous countries in the world.

Natural History.—The botany of Chili is exceedingly rich. Almost all the choicest European plants thrive in it, and it abounds in others, of which we know but the names, or possess merely specimens. Thirty-six species of quadrupeds have been enumerated by Molina, who has so well treated of this province. Eagles, vultures, and condors enjoy the heights and precipices of the Andes, and in the lower region are found great varieties of smaller birds.

3. Peru.—Stretching northwards from Chili, along the western coast, lies the Spanish province of Peru, in former times a powerful empire under a native prince. Great diversity of climate prevails in this region, but the heat is much more moderate than might be expected from the position with respect to the equator; and in the mountainous districts towards the east, a great degree of cold is experienced. Rain is seldom known in the lower parts of the country, where a plentiful dew, which falls during the night, supplies its place to the vegetable kingdom. Tempests, hurricanes, thunder and lightning, are nearly as rare; but earthquakes are often felt, and there is reason to fear that their destructive operation is constantly increasing.

Natural History.—There are immense forests spread over this province, indicating scantiness of population. The soil, however, is, in general productive, affording a profusion of fruits and flowers, and, in some districts, yielding a tree whose bark has been long celebrated as a restorative and tonic medicine.

Among the animals which swarm in this region, are mentioned the jaguar, tapir, cougar, a species of deer, the mountain cat, a sort of fox, and bears of a very fierce nature. Nor is the feathered tribe less diversified or interesting.

Before the annexation of Potosi and some other districts, formerly a part of Peru, to the vice-royalty of La Plata, the mineralogy of this province was perhaps the most copious, in point of the precious metals, in South America. But there remains enough in Lima, still attached to it, to render it of very high importance to the Spanish government. The mines of Lauricocha are said to have been discovered as far back as the beginning of the 17th century, by the accidental melting of silver, occasioned by a shepherd having kindled a fire for some common purpose. The mine of Guancavelica, which had supplied such immense quantities of quicksilver for about two centuries, is understood to be exhausted. Another was lately opened in the district of Huamalies, promising a rich supply. The gold and silver mines of Peru, together, are conjectured, on pretty good grounds, to have yielded about L.8,000,000 Sterling, in 10 years preceding 1790. Quito, which formerly belonged to Peru, was disjoined from it in 1718, in favour of New Granada.

The provinces, or intendancies as they are denominated, now included in Peru, are as follows:

Lima, whose city of the same name, situate about six miles from the sea, on the south of the river Rimac, in 12° south lat. is the capital of Peru; the city, which was founded in 1525, is computed to contain 64,000 inhabitants, is built of wood, but displays some very elegant edifices, and few places in the world have been so often visited and nearly ruined by earthquakes; *Truxillo*, north of Lima, having a capital of the same name, founded by Pizarro, a character well known in American history; *Tarma*, to the north-east of Lima, a district much inhabited by Indians; *Guamanga*, eastward of Lima, noted for its gold mines, and its capital of the same name was also founded by Pizarro; *Cuzco*, an inland district to the south-east of Lima; its chief city, Cuzco, which was originally the residence of the native kings when the Spaniards invaded this country, scarcely contains 16,000 inhabitants, the majority of which are Indians; *Arequipa*, a maritime district, to the south of Lima, fruitful in grain, and possessing a very mild climate; *Guantajaya*, north and west of Guamanga, formerly noted for silver mines, which are now abandoned; *Guancavelica*, between Guamanga and Lima, a hilly country, neither very fertile nor very agreeable; and the silver mines of this district have become almost useless from frequent inundations of water.

The population of Peru, as now constituted, perhaps does not much exceed 1,000,000, and in all likelihood is on the decline.

4. La Plata—is an immense region, made up of several provinces formerly reckoned distinct, and since 1778 erected into a vice-royalty, in which the chief dignity and power of Spanish South America may be said to consist. It is conceived to be bounded on the south by the province first described; on the west by Chili and part of Peru, from both of which it is separated by one of the ridges of the Andes; on the north by the parallel of 14° S. Lat.; on the east by the South Atlantic ocean and part of Brazil. On the southern extremity it is somewhat contracted by the ocean, where it is penetrated by the mighty waters of the river from which this province derives its name. Its length may be stated 1500 miles, and its breadth from 600 to 800. Beside part of ancient Peru, this vice-royalty includes the provinces of Buenos Ayres, Paraguay, Tucuman, Chaco, Los Moxos, Cuyo, &c.

Buenos Ayres is a vast plain, pervaded by the river La Plata, or the huge streams which form it, where they approach to mingle their waters before rushing into the ocean. The soil is in general rich, producing great varieties of grain, &c. and abounding in choice pastures, the abode of immense herds of cattle of the buffalo kind, wild horses, deer, &c. The purity of the climate is implied in the name of this province and of its capital, which is the residence of the viceroy and the seat of government. It is a fortified town, on the right bank of the river, but without any proper harbour, and carries on a respectable trade with many European ports. Its chief exports are hides of different kinds in the raw state.

Paraguay lies between a river of that name and the Parana, the great north and eastern tributary streams of the La Plata. It is rather a moist country, and very woody. Assumption, the capital, about 50 leagues higher up than the junction of the two rivers now mentioned, is but a small and rather ill-built town, pleasantly situate however, and having delightful gardens in its vicinity. The northern parts of this province are not much known. Altogether, perhaps, Paraguay has been neglected, in consequence, it is probable, of its being deficient in the precious metals, the original and strongest allurement on the minds of its European masters.

Tucuman, now divided into Salta and Cordova, lies between 23° and 33° S. Lat. and 61° and 68° W. Long. entirely inland. It is possessed of a mild climate and a fertile soil, and is withal well watered by several streams which run toward the river Parana. Few of its towns are large, and the whole province is reckoned to contain not much more than 100,000 inhabitants. Most of these, however, enjoy great affluence; in proof of which, it is mentioned by one Spanish writer, Estalla, that there is no person in it so poor as not to kill a heifer every day for the use of his family.

Cuyo, which is towards the west and south-west of Cordova, among the mountains of the Andes, has some vallies extremely fertile in fruits, and is noted for its wines. It is now considered as annexed to Cordova.

The country of the *Pampas*, to the south of Cuyo and Buenos Ayres, is very flat, and has scarcely any other inhabitants than some tribes of wandering savages, who can hardly be said to own the sovereignty of the Spanish nation. To the north of Tucuman are the provinces of *Chaco* and the *Chiquitos;* and north-west from the latter, *Los Moxos*. Of these we have but imperfect information; some native tribes still retaining chief possession, and admitting but little intercourse with the Spaniards. Indeed, it may be pretty confidently affirmed, that not more than one-half of the vice-royalty of La Plata has been examined by the nation to whom it forms so vital an object of policy. But the judicious counsels which effected the erection of this vice-royalty, so as to give it a preponderance over Peru, would perhaps have accomplished a survey of the districts composing it, if the affairs of the mother-country had been propitious to this distant interest. The frequency of land journeys between Buenos Ayres and the rich city of Potosi, which are in consequence now substituted for the tedious maritime expedition round Cape Horn, will, in time, it is likely, be imitated in other directions, and at last secure a profitable acquaintance between the various districts of this most important region. Certain recent events affecting the state of its dependence on Spain, may contribute to the celerity of so desirable an operation. It is probable, that a liberal constitution of government, and some abatement of the exorbitant influence of the clergy in this portion of South America, might materially modify the condition of the whole commercial world. To the chief cities of this vice-royalty, already mentioned, Buenos Ayres, the capital, Potosi, supposed to have 100,000 inhabitants, &c. we may add the following: Monte Video, on the north side of the river La Plata, at its mouth, noted for the best harbour in the province to which it belongs, and said to have 15,000 inhabitants; Cordova, in the district of the same name, a wealthy, handsome, and improving town; La Paz, north of Potosi, and capital of a province so called, a well-built, thriving place, with a population of 20,000 souls; Salta, in Tucuman, celebrated for an annual fair, at which, it is said, 4000 horses and 60,000 mules have been known to be assembled. The consumpt of these latter animals in the mountains of Peru, where they are chiefly taken, is astonishing. They are employed in carrying burdens from the mines, and in travelling. The town of Assumption, formerly mentioned, was at one time superior in extent and consequence to Buenos Ayres.

Natural History.—A naturalist would be amply rewarded for his labours in this region. In mineralogy, the objects are various and abundant. To botany its contributions are liberal, though the hand of science has hitherto been but sparingly occupied in their arrangement. Here are found the sarsaparilla, the sassafras, the guaiacum tree, that which yields the elastic gum, commonly called Indian rubber, the cinchona, or jesuits' bark-tree, the nux vomica tree, great varieties of palm, fruit-trees in immense profusion, and of the richest kinds, particularly pomegranates, pine-apples, oranges, figs, peaches, &c. Of the animal kingdom, so copious in La Plata, we may notice the elk, ant-bear, jaguar, or American tiger, a species of hippopotamus differing from that found in the Old World, several kinds of large and small serpents, the ostrich and condor. The people, in general, throughout this vice-royalty, computed at 1,000,000 Spaniards or Creoles, and a comparatively small number of natives, are described as enjoying supreme earthly advantages. The former are, on the whole, well educated, courteous, handsome, and attached to pleasure. Since the complete establishment of their power, it is probable that the latter have been treated with kindness, which could not fail to conciliate, if the recollection of past events were friendly to attachment.

5. Brazil.—Hitherto we have treated of provinces, either in part or altogether subject to the Spaniards, and have had occasion to remark the imperfection of the accounts which they have published respecting them. Equal, if not greater jealousy, and certainly a larger share of ignorance, have prevented their neighbours, the Portugueze, from informing the world of the particulars of their possessions in South America. This is the more to be wondered at by an inhabitant of Britain, who cannot but expect some liberality of communication in favour at least of his own nation, which has long been justly considered as the main support and most faithful ally of the parent state. It is undoubtedly a subject of the deepest regret to every enlightened mind, that one of the fairest portions of the universe should have fallen into the hands of a people too stupid to do it justice by their mode of management, and too narrow-hearted to give it the chance of even charitable improvement by an honest display of its real condition.

Of Brazil, to which we now allude, we have the more reason to regret the scantiness, and perhaps inaccuracy of our knowledge, as, from its position in the American continent, it perpetually urges and perpetually mocks our keenest curiosity.

Brazil may be said to be bounded on the south and west by the Spanish provinces last described, on the east by the Atlantic ocean, and on the north partly by the same, and partly by the river Maragnon. The treaty of St Ildefonso, in 1777, between the Spaniards and Portugueze, strictly defined its limits. This region, possessing great variety of soil and climate, has been divided into several provinces.

Rio Janeiro, including *Rio Grande*, extends from Buenos Ayres to the province of Bahia, and is bounded on the east by the sea, and a chain of mountains on the west. It is well watered, has an excellent climate and fertile soil, possesses some rich gold mines, and contains a population of above 100,000 souls. The capital of the same name, or St Sebastian, as it is called, the greatest commercial city in Brazil, is large, elegant, and wealthy, but is very unhealthy, in consequence of the situation being near some extensive forests, which are supposed to occasion too humid an atmosphere.

Bahia, to the north of the preceding province, and stretching along the eastern shore, is reckoned the most populous, if not the most opulent of the Brazilian government. The inland parts are covered with forests; and the towns on the coasts are neither very considerable nor very inviting. Bahia, or St Salvador, the capital, though large, has no pretensions to elegance, and is inhabited by a set of people who are little attentive to cleanliness and improvement. Since the Dutch, an industrious nation, were obliged to abandon this country, there has scarcely one effort been made to arrest or to banish indolence and torpid luxury. The principal people are generally carried about in palanquins by their slaves, of whom the consumpt is so rapid that it is thought almost miraculous when any of them survive seven years.

Pernambuco, the most easterly province of Brazil, is still farther towards the north, and, with the exception of its western or internal side, is almost entirely bounded by the ocean. Some of its extensive plains afford plenty of cotton and sugar. There are several towns and villages on the sea coast, of which

South America.

Olinda is the largest; but the narrowness of its harbour, in addition to circumstances quite congenial to the character of the Portugueze, has prevented it becoming of much importance.

Maragnon and *Para*, two provinces to the north and north-west of Pernambuco, the former of which is partly on the coast, and the latter is washed on its northern limit by the waters of the river Maragnon, though large, afford little to interest the lover of civilization and improvement. Much of the country is uncultivated, and the population is scanty throughout.

With the inland provinces our acquaintance is still more circumscribed. In the mountains of one of them, *Matto Grosso*, there are gold mines; and in those of another, *Minas Geraes*, are found most of the diamonds for which this country has been celebrated.

The natural history of Brazil differs little from that of some of the regions already described.

6. Guiana.—Between the rivers Maragnon and Oronoco, bounded on the east by the Atlantic ocean, and on the west by a line drawn along the river Negro, are situate those provinces classified under the general title of Guiana, and particularized by the names of those European nations which earliest obtained the property of them, as *Portugueze, Dutch*, and *French*. The climate is on the whole temperate, allowing for geographical position, and the soil very variable. Dutch Guiana is most known. It contains the colonies of *Surinam*, *Berbice*, *Demerara*, and *Essequibo*. These are important settlements, and whether in the hands of the British or Dutch are likely to experience very rapid improvements. Coffee, cocoa, sugar, cotton, are the chief exports. French Guiana was taken possession of by the British and Portugueze in 1809. It differs little from the former in point of climate, soil, and productions. A good deal of labour is requisite to render either very healthy, viz. clearing forests, and draining marshes, &c.

The botany of Guiana, in general, is represented as peculiarly interesting, and so must the zoology, if abundance of reptiles can be conceived a strong enticement to its study.

A territory in some maps denominated *New Andalusia*, or *New Cumana*, has of late received the more appropriate title of *Spanish Guiana*. It is to the north of the Portugueze possessions, is bounded on the east by the ocean, on the south by Dutch and French Guiana, extends along the Oronoco, which forms its northern limit, but is somewhat indistinctly defined on the west. Hitherto it has not been much explored; but the researches of Humboldt have proved it to be highly interesting. In this province it is that the junction takes place between the Oronoco and the Maragnon, by the intervention of the Negro. This singular circumstance, which had been noticed in a map of the country as early as 1713, but afterwards frequently denied by those who might be supposed acquainted with the fact, was completely confirmed by the traveller now mentioned. According to him, the navigation is extremely hazardous, and a vast space of country which he traversed throughout in effecting it, was quite destitute of inhabitants. The whole population of Spanish Guiana, indeed, is conjectured to be no more than 34,000, and there are only four towns and three villages in the province.

South America.

7. Caraccas.—This province, which belongs to Spain, lies on the north side of the Oronoco, and is bounded on the east by the gulf of Paria, which divides the island of Trinidad from the continent, the Caribbean sea on the north, and the vice-royalty of New Granada on the west. It comprehends various districts, as *Cumana*, *Caraccas proper*, *Venezuela*, *Maracaibo*, and *Varinas*, which, with the island of *Margarita*, belonging to the same government, are estimated to have a population of upwards of 700,000 souls.

A straggling branch of the eastern Andes, pervading this province, modifies the temperature of the climate, and furnishes a multiplicity of streams and rivulets which fertilize the level countries to the north and south of its range. Nor are the heights themselves incapable of supporting inhabitants. The lake of Maracaibo, a sort of sea or gulf, reckoned upwards of 100 miles long, north and south, and 50 or 60 in breadth, is a singular feature in this country, productive of no trifling benefits. It is navigable for large vessels. The town of the same name, built on the western shore of the lake, is a place of some consequence, containing about 20,000 inhabitants, and carrying on a tolerable trade in cocoa, tobacco, and hides. If the situation were not somewhat unhealthy, and storms and earthquakes were rarer, its prosperity would certainly be more conspicuous.

Caraccas, the capital of the whole province, is a still more flourishing town, and has about double the population. Though built in a valley, its elevation above the sea is more than four hundred fathoms, which may occasion the salubrity and mildness of the atmosphere. The inhabitants are a gay, luxurious, but not inactive race, and are particularly zealous for the doctrines and practices of the Romish Church. This town is often called St Jago de Leon. Cumanas, in the province so named, has upwards of 20,000 inhabitants, most of whom are Creoles.

There are many more towns scattered throughout this country, and an immensity of villages, from which it is warrantable to make an inference in favour of its character. To this spot the attention of Europe has been for some time directed, to witness a contest between an arbitrary, but really imbecile government, and its subjects, just opening their eyes to their true interests, in which it is impossible, at least for a Briton, not to feel his heart and judgment anxiously engaged. An issue, such as he would hope for, might be followed by beneficial consequences to the rest of South America, which it is totally absurd to suppose will ever be the creatures of will and ability on the part of the superannuated authorities.

8. New Granada—is an extensive and highly interesting vice-royalty. Its somewhat singular position will be much more easily ascertained by inspecting a map than from any verbal description. On the north it projects into the Caribbean sea, which is merely a portion of the Atlantic ocean, while its western outline is washed by the great Pacific ocean, and on the south and east its boundaries are constituted by the river Tunguragha, and part of the Mar-

South America.

agnon and Negro. In this extensive space are included various districts.

Quito, which formerly belonged to Peru, now forms a part of New Granada. Much of the country is still unexplored. It extends from the ocean on the west to the Portugueze settlement in Brazil on the east, and from about 2° S. to 2° N. Lat. The features of this country are perhaps the grandest in the world, and the frequency of earthquakes and destructive tempests, by occasioning perpetual changes, gives it a degree of interest which scarcely any other region produces. The soil appears to possess an incessant and inexhaustible fertility, hardly ever requiring the least indulgence of time, as if nature, continually apprehensive that the terrible convulsions to which she is liable, would obstruct her operations, were determined to yield the full amount of her blessings before their occurrence. No sooner, then, is one crop ripened, or one series of fruits brought to maturity, than others succeed with a rapidity and profusion which rather oppress than gratify the inhabitants. These favours, however, though sufficient to tempt a large population, do not counterbalance the precariousness and brevity of human existence. Some varieties of climate are to be met with in this region, dependent on peculiar situation with respect to the sea and the mountains. The city of Quito is large, well built, thriving, and contains about 60,000 inhabitants, Spaniards, Creoles, and Indians. It is situate almost exactly under the equator, on a level plain, 9000 feet above the level of the sea; a circumstance essentially favourable to the temperature of the atmosphere. Like other towns in this region, it has often suffered from the causes already mentioned, and still oftener witnessed with horror the devastation of the towns and villages around it. An earthquake took place in this province on Feb. 4. 1797. Quito itself suffered little in reality; but the people dearly purchased prolonged existence, by a state of apprehension approaching to the highest frenzy, and the view or agonizing tidings of the irremediable calamities which it inflicted. Some places were instantaneously swallowed up by the yawning earth; others were overwhelmed by water; the fall of mountains, shaken from their base, proved a terrific instrument of devastation: and the pestilential vapours arising from the bodies of those whom some such catastrophe had not buried, still more extensively spread this compendious ruin.—Upwards of 35,000 persons are said to have perished.

Guayaquil and *Cuença*, districts to the south of Quito, but once reckoned part of the ancient kingdom of that name, are well accommodated for trade by a large gulf and several bays or creeks, one of which in the former affords the choicest harbour on this coast. The two cities, of the same name with these provinces, are large, and on the whole improving, though not to the amount of their advantages. Guayaquil is celebrated for the beauty of its women. Cuença is surpassed by few towns in respect of local benefits.

Popayan, north of Quito, is almost entirely situate in the Andes, and possesses a temperate climate, considering its latitude. In some of the mountains of this province, as indeed throughout Granada, are mines of gold and precious stones. Popayan, the capital, is a neat little town, enjoying almost perpetual spring, with all the plenty and luxuriance of summer.

South America.

Choco, to the north, and formerly reckoned a part of Popayan, differs little or nothing from it in soil, climate, and productions.

Santa Fe de Bogota, is nearly in the centre of this vice-royalty; and in consequence, more perhaps than of any other circumstance, its city, of the same name, is made the seat of government. This province is hilly, well-watered, and enjoys a mild climate. The capital contains 40,000 inhabitants, is an archbishoprick, can boast of an university, and, besides other advantages, is the residence of some of the most distinguished Spanish families in South America. Of the districts to the east of the Andes, in the direction of the rivers Napo, Parana, (both branches of the Maragnon) Negro, and Oronoco, denominated *Macas*, &c. very little is known.

What remains to be noticed may be conveniently divided into two parts; one comprehending the districts of *Santa Martha*, *Carthagena*, and *Zinu*, in the north; and the other, commonly denominated the isthmus of Darien, or Terra Firma, which is formed by *Choco* already mentioned, *Biruquete* to the west of it along the sea coast, *Darien*, and *Panama*.

Santa Martha is the most eastward of the first part, being separated from Maracaibo, or Venezuela as it is often called, by a branch of the Andes, and bounded on the north by the Gulf of Mexico, having Bogota on the south, and Carthagena, from which it is parted by the river Magdalena, on the west. The mountains are often covered with snow, and the plains are fruitful in grain, &c.; but the population is scanty, and its chief town, of the same name, is rather on the decline. This place was destroyed by Sir Francis Drake in 1585; and the new town often suffered from the buccaneers, who infested this coast.

Carthagena and *Zinu* are much in the same predicament in every respect. Their position along the gulf we have named, at one time so much traversed by Spanish galleons, &c. seems still to invite the efforts of commerce, and some good havens promise security and abundance. But, by a fatality that attaches to almost every thing Spanish, both natural and incidental advantages are either rendered useless by indolence, or are prostituted to a luxurious superstition. Carthagena is a handsome town, with more than 20,000 inhabitants, who have of late become attached to the manners and dress of Europeans, from whom it is to be wished, that they had acquired also a taste for beneficial studies, and a spirit of industry. This place has been often visited by hostile fleets. The river Magdalena is navigable for small vessels to a considerable distance from its mouth, and the towns on its banks are supported by the trade between Quito and the northern districts.

Birquete, a small district on the western coast, as it were skirting Choco, presents nothing of importance to our attention.

North America.

Darien, an unhealthy territory, was once well inhabited, but has declined rapidly in modern times, in favour of wild beasts and reptiles, which swarm in almost primæval security. On the northern shore of this district, near what has been called the gulf of Darien, a body of Scots to the amount of 1200 formed a settlement in the year 1699, which they denominated, in honour of their native country, New Caledonia. It was of short duration; for it was inadequately supported by the parent state, and indeed invidiously regarded by the English East India Company, who had sufficient influence to contribute essentially to its ruin. The recollection of its miseries and hard fortune long operated most injuriously on the state of affection between the sister kingdoms.

Panama, which forms the junction of South and North America, like the other districts now enumerated, has dwindled into comparative insignificance. It was never either very fertile or very salubrious; but a brisk trade, for which it was conveniently placed, gave it importance at one period. The town of Panama, on the west coast, rendered of consequence by its participation in the trade established over land between the gulf of Mexico and the coast of Chili and Peru, had some pretensions to be thought both elegant and wealthy, previous to the decline of commerce, and a fire which took place in 1784. Portobello, on the north coast, has suffered nearly in an equal degree from a similar cause. Its excellent harbour might retard its decay, if the temperature and salubrity of the climate were proportioned to the convenience of its position. The forts which defended it were destroyed by Admiral Vernon in 1739.

II. North America.

North America extends from that part of the isthmus of Darien which we last described, to a degree of north latitude not exactly ascertained, but which certainly exceeds 70°, and is comprehended between the 52° and the 167° of west longitude. Without comprehending Greenland, it may be reckoned at about 5000 miles long, and to have a breadth varying from 60 to upwards of 4000 miles. Its form is singularly irregular, presenting a multiplicity of projections and indentations; and the frequency and vast size of the seas and lakes which pervade it, or are studded on its surface, suggest the notion that it has been but lately and imperfectly recovered from the ocean.

The mountains are not so lofty as those of the southern division, but they are of vast extent. The chief ridges are, one arising from the isthmus which connects the two portions of America, and running with considerable deviations nearly in a north-west direction, and another on the eastern coast, to which it forms nearly a parallel line. The space between these chains may be considered as a vast elevated plain, intersected by rivers, and spotted with lakes, having few eminences, and these merely subordinate to the high ranges by which it is skirted.

Rivers.—The rivers of North America are inferior to those of the southern part, but will bear comparison with those of the Old World. The Mississippi is entitled to the first place. It rises from the eastern side of the mountains on the west of the great inland plain above-mentioned, which it traverses in a south or south-eastern direction, falling into the northern part of the gulf of Mexico, a distance, it has been variously alleged, of from 1400 to nearly 3000 British miles.

North America.

The St Lawrence is the next in importance, and, in breadth of outlet, indeed, is superior. Issuing from lake Ontario, and performing a course of 700 miles, it flows into the North Atlantic ocean, at the gulf or bay which bears its name. Its source ought to be traced to lake Superior, or even lake Winipec, which would vastly increase its nominal consequence. The Ohio, a branch of the Mississippi, and which itself is formed by two considerable rivers, the Alleghany and Monongahela, in addition to several minuter streams, is understood to run a course of more than 1000 miles. The name of the Alleghany is derived from the great ridge of mountains on the eastern coast, whence the river so called has its source. North America is still imperfectly explored, particularly towards the north, and on the western side, where it cannot be doubted that very important discoveries are reserved for the resolution and enterprise of succeeding travellers. Political geographers conceive the whole of North America to be divided among the three powers of Great Britain, the United States, and Spain, with the exception of such remote or little known districts as are still in the hands of the native tribes; to which, though of scarcely any importance, may be added an extremely small portion on the north-west coast, in the vicinity of Asia, to which Russia may attach a doubtful, and by no means an enviable claim.

The first portion we have to consider occupies the remainder of the isthmus by which North and South America are united. To the whole is sometimes applied the title of Mexico, or New Spain; this last acknowledging the power to which it has been subjected since its discovery by Europeans. But we ought to apprize the general reader, that the application of names to most part of the Spanish possessions in America, has been frequently and variously modified, so as to occasion much perplexity of description.

Mexico lies between the latitudes 7° and 23° N. and the 88° and 107° W. longitude. It is more than 2000 miles long from south-east to north-west, and of very variable breadth. The narrowest part of the isthmus, which is in the district or province of Veragua, is said to be no more than 25 British miles across; but the average breadth may be stated at 400. The mountains of the isthmus, which have been supposed a mere continuation of the Andes, and which are said to be prolonged to the northern continent, are very lofty. Orisaba, for example, is visible at the distance of 60 miles, and many of them are commonly covered with snow; several are volcanic; their courses are extremely varied, but may be said, in general terms, to lie in the direction of the isthmus; and they are the source of many small rivers which run on both sides towards the ocean. The declivities of these mountains are profusely covered with trees, shrubs, &c. of various

North America.

kinds, forming the secure abode of numerous species of birds. Plants, of the finest form and colours, are copiously distributed throughout the lower lands, and contribute to the beauty of this fine region.

The rivers are small, but their numbers promote the fertility of the soil, which, like that of most tropical countries, is more productive of fruits than of grain. The lakes are numerous; and Nicaragua, in the south, is the most important.

The climate of this region is, on the whole, favourable. The extreme heat, to which its situation subjects it, is greatly tempered by frequent rains and the predominance of alpine elevations. But storms are not rare; and the occurrence of earthquakes lessens the weak security of human happiness.

Among the animals of this country are, the porcupine, a species of panther, which sometimes grows to the size of a large ox, the bison, the buffalo, wild goats, wild horses, apes of numerous species, armadillos, snakes of huge magnitude, many curious sorts of birds, &c. The precious metals are found in many districts, and have often been wrought to advantage.

Veragua, though politically attached to the viceroyalty of New Granada, is certainly a part of North America. It adjoins Panama, is very woody and mountainous, and subject to frequent and heavy rains, which render it unhealthy. The population is scanty, and the country has been little explored; yet it is reckoned rich in gold, and possesses one or two good harbours. There are several islands on its coasts. *Costa Rica*, a province to the northward, has its name from its rich mines of gold and silver, which have been abandoned from the difficulty of working them. In its general features it resembles Veragua.

Nicaragua, lying in about 12° N. Lat., is amazingly woody, but has very fertile plains, watered by the river Yare, and several smaller streams. The lake of the same name is about 170 British miles long, and nearly half as broad. Opening into the gulf of Mexico by the river St Juan, and connected, as is believed, with the Pacific ocean, by a little rivulet, this lake seems to court the industry of man to effect a navigable junction between the two oceans.

Honduras, attached to Nicaragua on the north and north-east, is on the whole a flat country, abounding in wood. From the bay formed by this province and the coast of Yucutan, in the gulf of Mexico, is obtained much of the logwood of commerce; and the bay of Campeachy, on the north of Yucutan, furnishes immense quantities of mahogany.

Guatimala is applied both to a small district and to a large province constituted by several districts, forming the third audience of the older division, or sometimes the Commandancy of Guatimala. St Jago, the capital of Guatimala, and seat of the third royal audience, the president of which is amenable to the viceroy of Mexico, was built near the west coast, between two mountains, one of which is a volcano. It was injured by an earthquake in 1751; a similar event took place in 1775, by which the new city, on the same site, was utterly destroyed, when upwards of 100,000 persons were lost. The situation for a capital was afterwards changed. Ciudad Real, the chief city in Chiapa, has some trade in chocolate, cotton, cochineal, sugar, &c.

The Audience of Mexico comprehends seven provinces. *Yucutan*, lies between the bays of Campeachy and Honduras, in about 20° N. Lat.; is nearly 300 miles long, and is sometimes called Merida, from its capital. Cotton, indigo, maize, &c. are the products of this district. There is reason to believe that this country was once under the waters of the ocean. *Tabasco*, to the west of Yucutan, a flat, moist, and rather unhealthy country, is exposed to intense heat, and to rains for about nine months in the year. *Guaxaca*, or *Oaxaca*, is north of the preceding, and occupies the whole breadth of the isthmus. It is very rich in cochineal, produces also silk in abundance, and, on the whole, is more generally fertile than any of the other provinces. The capital of the same name is a large and elegant city, situate in a fine valley, and containing more than 20,000 inhabitants. It is a bishop's see. Gold is found in most of the rivers of this province. Industry on the part of the people is all that is wanting to bring this country, and particularly the capital, to the highest prosperity.

Tlascalà, north-west of the preceding, extends 60 miles along the west coast, and 180 along that of the gulf of Mexico. Though very rocky and mountainous, it has some fine valleys. The people of this province are noted in the history of the conquest of Mexico by the Spaniards, to whom they afforded essential aid. Certain immunities are still enjoyed as the rewards of such services. Puebla de los Angelos, now the capital, is reckoned the second city in New Spain, and is inferior only in population to Mexico. It is said to contain 60,000 inhabitants, is well built, possesses some elegant churches, two colleges, twelve nunneries, and a great many convents. Several manufactories of cotton cloths, earthen ware, iron goods, and soap, which last is so good as to be in great demand even in Spain, have been established. Two towns of the name of Vera Cruz, both in this province, and Xalapà, which gives its name to a valuable root used in medicine, Jalap, found in its neighbourhood, deserve to be mentioned. A curious discovery was made in the northern part of the province about 50 years ago. It is a pyramid, supposed to be of very high antiquity, situate in the middle of a thick forest. Its perpendicular height is about 60 feet, its base an exact square of 82 feet, and it is composed of large stones, nicely polished, and covered with hieroglyphics. No satisfactory explanation of this singular structure has been given, or perhaps can be expected.

Mexico Proper, to the west, or north-west of *Tlascala*, has the Pacific ocean on the south, the small province of Panuco on the north, and is bounded by that of Mechoacan or Valladolid on the west, and is 300 miles long and half as broad. It enjoys a healthy climate, a fertile soil, and is the seat of the capital of all Spanish America. Of this very singular and important city we shall reserve a description for another part of our work. We shall therefore merely mention that Mexico is singularly situate on a lake, displays some superb buildings, and has a population exceeding 130,000. Acapulco, on the coast of the Pacific ocean, is a town long noted for trade, now on the decline. It may be reckoned the port of Mexico on one side of the isthmus, as Vera Cruz is on the other. Queretano, to the north of Mexico, is second to it as to extent in the vice-royalty. It is very beautiful, and contains more than 40,000 inhabitants.

The Audience of *Guadalaxara*, or *New Gallicia*, also comprehends seven provinces, but none of them presents any thing worthy of particular notice.

San Luis Potosi belongs to New Spain. It is on its north-east side, and lies partly on the shore of the gulf of Mexico. San Luis Potosi, the town so called, contains 12,000 inhabitants.

Louisiana extends along the north shore of the gulf of Mexico to the river Mississippi, and indefinitely towards the north, being reckoned, however, about 1,200 miles long, and from 300 to 400 broad. A nominal distinction into Upper and Lower has been applied to this region; in the first, towards the north, a greater degree of cold prevails than is usual in the corresponding latitudes of Europe; and the second is not scorched by excessive heat as those of Africa. On the whole, with some exceptions, the climate is mild, and, unless immediately on the coast, the soil is fertile; but much of the country is covered with forests, and the bulk of it has hitherto been imperfectly cultivated. The population is supposed not much to exceed 40,000, that of Upper Louisiana being, according to Volney, only 2,500, which is extremely disproportionate to the extent. New Orleans, the capital of Louisiana, near the mouth of the Mississippi, is admirably situate for trade, and has made rapid advances in size and importance. New Madrid, up the country, and on the same river, at some distance from the influx of the Ohio, is likely to experience no less a share of prosperity. Indeed, it is scarcely possible to doubt, that this province, to whomsoever it may eventually belong, is destined to acquire a degree of respectability which will render it of essential importance in the scale of commercial nations.

On the west of Louisiana, stretching across the continent to the gulf of California, and beyond the peninsula of that name, to the Pacific, are two provinces, formerly reckoned distinct, but now comprehended in the vice-royalty of New Spain, viz. *New Mexico* and *California*. The progress of these towards civilization has hitherto been so tardy as to furnish scarcely any topic worthy of particular notice, and the reports of travellers are too scanty and imperfect to make up the deficiency. The climate may be declared temperate, and the soil in many places is genial, and well supplied with water from an abundance of rivers.

Unless by navigators on voyages of discovery, the west coast of America, from California to the highest attained north latitude, has been very little visited. These, however, have nearly completed its geography, as may be seen by inspecting recent maps. Our own countrymen have contributed materially to this object. France, Spain, and even Russia, are entitled to the credit of some discoveries; and, of late, the government of the United States appears anxious to promote the knowledge of a coast which may one day minister to their rapidly accumulating energies.

Nootka, or King George's Sound, lying in about 49° 36′ N. Lat. and 126° 42′ W. Long. has attracted some attention, rather because the question respecting the property affected at one time the understanding between Great Britain and Spain, than from its own merits. All claim to it was yielded in favour of the former power in 1790, and about five years afterwards it was taken possession of by the sovereign whose name it bears, since which it seems to have ceased to interest the public mind; but it may prove a point of some consequence, when the United States, in prosecution of views which time is developing, shall have succeeded in establishing a colony at the mouth of the Columbia, to which, it is extremely probable, the late expedition of captains Lewis and Clarke across the continent, was intended to conduce. To the account of this expedition, published from the official report to the American government, we refer for much curious information respecting the countries over which they travelled, and the mighty rivers by which those regions are traversed.

Cook's Inlet, the entrance of which lies in about 60° N. Lat. is distinctly ascertained to have no communication whatever with any coast on the north or east. The hopes, indeed, which had long been entertained, that such a communication between the Pacific ocean and Hudson's bay, or some other sea leading into the Atlantic, would be discovered, may, with perfect confidence, be asserted altogether unfounded as to any point on the west coast of America so high up as has ever yet been reached.

From near the north side of Cook's Inlet, or river, as it is sometimes improperly called, the coast suddenly projects westwards, forming the peninsula of Alashka, or Alyaska, from the extremity of which a chain of islands stretches out so as to approach near Kamtschatka on the continent of Asia. These islands, and the peninsula itself, furnish wretched employment to a race of beings, nominally under Russian protection, but whose calamitous history, as related by captain Krusenstern, in the account of his circumnavigation, would appear to render it doubtful if the intervention of a civilized government had ever been exerted in their behalf. Their occupation is to collect furs from the foxes and other animals which are found in these regions. A more dismal picture of tolerated miseries was never published than what is given in the account by the officer (himself a Russian) now mentioned, of the injustice and barbarous policy to which they are subjected, by a company possessing a legal right to profit by their miseries.

Cape Prince of Wales, in 66° N. Lat. is the extreme north-west point of the American coast hitherto explored. It is little more than twenty miles distant from a corresponding projection in the continent of Asia, the passage between which is denominated after the navigator who discovered it, Behring's Strait.

The highest point reached on the west coast of America, is that of Icy Cape, beyond which captain Cook found it was altogether impossible to proceed, from the multitude and magnitude of the masses of ice that obstructed his navigation.

The whole of this coast is said to bear a great resemblance to that of Norway, especially in the circumstances of its being skirted with inlets, projections, and small islands, and crowned at some distance inland with lofty ridges of mountains. The inhabitants throughout are nearly in a savage state, but divided into various tribes, having various appearances and manners, and often engaged in hostilities with each other.

In passing from Icy Cape, towards the east coast of America, there are few objects to detain our attention. Indeed, the whole of the north coast between that cape and Davis' strait is totally unknown, with the exception of two points ascertained by captain Hearne in 1770, and Mr Mackenzie in 1789, to the published reports of whose travels we must refer for particulars respecting the lands, natives, and productions of these high latitudes.

British Possessions.—The boundaries which are uncertain on the north, are Davis' strait and the Atlantic on the north-east and east, the possessions of the United States on the south-east and south, and may eventually be extended to the Pacific on the west, though the intermediate space, nearly 100° degrees of longitude, be at present almost totally independent of the British empire.

The northern coast of Hudson's bay has been seldom visited, and is too inclement to tempt much enterprise. Even those lands which are round its western, southern, and eastern shores, below the latitude of 60°, present topics only of doubtful interest. Since the discovery of this inland sea, in 1610, by the person whose name it bears, it has been frequently visited with the view of ascertaining the existence of a passage into the western ocean, but always without success. The common opinion, now entertained, that this sea does not afford any such passage, may be considered as demonstrably true. The entrance into the sea from the north-east is by a strait proceeding from Davis' sea, about 600 miles long, and lying between 60° and 63° of latitude, of very variable breadth. This strait is practicable only during summer, and even then not without danger. The bay itself is scarcely navigable above four months in the year, from the prevalence of ice, besides being always hazardous from the number of small islands, rocks, and sand banks. Several rivers open into it; but as their mouths are generally filled with shoals, there are few places on the coast which afford good ground for ships to lie on. The depth of water in the middle has been ascertained 140 fathoms. It is very sparingly supplied with fish. Whales, both of the common kind, and of the Beluga species, are known to frequent it in considerable numbers. This induced the company, who so early as 1670 obtained a charter investing them with the property of a large portion of this region, to establish a fishery. But the expence of managing it, and a variety of difficulties, occasioned its abandonment in 1771.

The lands on the west of Hudson's bay have been denominated New North and South Wales. In general, the soil is so barren as to give no hopes of ever being useful; some very small trees, moss, and occasionally a little grass, are the only vegetable productions, and the inclemency of the weather seems to preclude almost the possibility of improvement.

Fort York, lying between two branches of the river Nelson, in $57\frac{1}{2}°$ of latitude, is the centre of the commerce carried on in this bleak region. To the south-west of this factory, as the chief places of the commercial establishments scattered in this country are called, but at a considerable distance, lies lake Winipeg or Winipec, which receives several streams from the west, some of which are supposed to arise near the source of the Mississippi. The Hudson's bay Company claim the sovereignty of these territories, parts of which, however, are apt to be questioned as the property of the United States. On a part of this assumed property purchased from the Company, and lying on the Red river, the Earl of Selkirk lately attempted to form a settlement of emigrants, chiefly from the Highlands of Scotland. The right of disposal has been denied, and the absurdity of the speculation attempted to be shewn in a letter to his Lordship, by Dr Strachan rector of York in Upper Canada, published in 1816. The opinion that the undertaking was injudicious, is supported by its complete failure.

The eastern coast of Hudson's bay is denominated East Main, and forms a part of the large country to which the Portugueze who discovered it gave the very inapplicable name of Labrador, i. e. Ploughman's Land, but which has been recently called, with as little propriety indeed, New Britain. It is bounded, on the east by Hudson's Bay, on the north by the strait of the same mariner's name, on the east by the Atlantic, and part of the gulf of St. Lawrence, and on the south by Canada. The interior, which is scarcely known, is, in general, hilly and barren. The inhabitants, who are few and poor, are known by the name of Esquimaux, and bear great resemblance to the people of Greenland. They are very peaceable, and as they possess a rather unusual share of docility, have done justice to the zealous exertions of the Moravian brethren, who commenced settlements among them about 1764. Since that time, some tracts have been cultivated and several useful arts introduced, which, with the establishment of a fur trade and fisheries, and certain natural advantages, render this country an object of no inconsiderable interest. A peculiar shining stone, of variable colours, called Labrador spar, is found on the shores of the sea and lakes in this region, but hitherto the parent rocks have not been discovered.

Newfoundland, an island of a triangular shape, about 900 miles in circuit, is separated at its north-west extremity from the coast of Labrador by the strait of Bellisle, which stretches out towards the south and forms part of the gulf of St Lawrence. It is bounded by this gulf on the west and north west, and on the east and south by the Atlantic. Few persons have penetrated into the interior of this island; but its coasts are well known, having been long frequented for its extensive fishery. It is a hilly country, occasionally covered with some of the smaller sorts of alpine trees, &c. The climate is vastly more severe than might be expected from the latitude, viz. between about 46° and 51°, which corresponds with part of France in the Old World. On the banks of the rivers, which are plentiful in this island, good pasture is abundant; and it cannot be doubted, that, in course of time the hand of man will recover the soil from its nearly barren condition. But the chief inducement to visit the island is the abundance of fish off its coasts, so that few families reside on it with any serious intention of promoting its agricultural welfare. The chief towns are, St John's, near cape Spear, on the south-east coast, a small dirty place, with a good harbour; and Placentia, also a small place, in an excellent bay of the same name, on the south coast. The bays and harbours are numerous, and many of them both safe and commodious. The fishing bank of Newfoundland, more precious than a gold mine, lies to the south of the island, and is reckoned more than 400 miles long and 200 broad.

Royal Island, or Cape Breton, in the gulf of St Lawrence, is about 100 miles long, and of very irregular shape, has a cold, foggy climate, a scanty, ungenerous soil, and a population of about 1000 souls. Its coasts are bold, and its harbours somewhat difficult of entrance. Since it was ceded to the British, in 1763, the fortifications which its former masters, the French, had erected in different parts, especially at the port of Louisbourg, on the south-east coast, have been demolished. The fishery, of which this island was the chief seat, and for which alone, perhaps, it is of any value, was calculated to yield the French at one time no less than a million Sterling yearly. There is an extensive bed of coal in the island.

The island of St John, to the west of the preceding, is reckoned 60 miles long and 30 broad; is, on the whole, very fertile, well watered, in a tolerable state of cultivation, and has upwards of 5000 inhabitants. It has been denominated the Granary of Canada; a term which implies at least its comparative productiveness. In many respects it is a highly advantageous appendage to the British dominions in this quarter of the world.

The islands now mentioned are separated by a narrow channel from the province of Nova Scotia, which is connected with the continent by a neck of land at the bottom of the bay of Fundy. It is about 300 miles in length, and, on an average, about 80 in breadth. The soil is unfruitful, except on the banks of rivers, where a little grain, some grass and flax are raised. The climate is cold, and subject to fogs, and cannot be reckoned healthy. The inhabitants are not numerous. Its convenience for fishery is the chief excellence of this province. The timber grown here in large quantities, is generally of a small size, and under the name of lumber is carried to the south. Good harbours abound on the coast; on which the tide is remarked sometimes to attain a very uncommon height, as from 50 to more than 70 feet. Halifax, the capital of this province, is a thriving town, on the bay of Chebucto, and contains 5000 inhabitants. Annapolis, a small town on the south-east of the bay of Fundy, is noted for its safe and commodious port. Most of the other towns in Nova Scotia are very trifling in size, but that of Shelburne was estimated in 1799 to contain about 9000 inhabitants, many of whom were loyalists who had emigrated from the United States.

The province of New Brunswick, which, till 1784, was comprehended under the same name with Nova Scotia, is divided from the territories of the United States by the river St Croix; is watered by a considerable stream, the river St John, which is navigable a good way from its mouth for vessels of 50 tons; has several lakes, one of which is 30 miles long and nine broad, and is traversed on the north-west by a branch of the Appallachian mountains. Fredericktown, on the St John, is the capital.

Canada is bounded on the north by Labrador, the southern coast of Hudson's bay, and that region on the west of the same bay called New South Wales; its eastern limit is marked by the bay or gulf of St Lawrence; on the south and south-east it terminates in Nova Scotia, taken in its largest signification, and the property of the United States; while, on the west, it stretches indefinitely among the little known lands still possessed by independent tribes of native Americans. Its greatest length from east to west is variously reckoned from 600 to upwards of 1000 miles, and its breadth from north to south from 200 to 400 miles. A line, partly imaginary, and partly marked by the river Outawas, or Utawas, divides it into Upper and Lower Canada; the latter being to the north-east of the former, and consequently nearer to the mouth of the St Lawrence.

Soil and climate.—This country, on the whole, is hilly and much covered with trees, having but a thin, and naturally not very fertile soil, unless in some of the plains, especially in Upper Canada, where vegetation is more abundant and the climate milder. The labour of cultivation, however, where skilfully directed, has been tolerably well rewarded by crops of grain and useful vegetation, in addition to some good pasturage. Certain of the smaller fruit trees, too, are found to be productive; nor ought the maple to be forgotten, as affording a saccharine substance much used in the country. Summer and winter run suddenly into each other, with scarcely any intermediate seasons, and the effect of both is amazingly great. Thus, snow falls to the depth of many feet, and the mercury in the thermometer has sometimes been frozen; while, on the return of warmth, a thaw almost instantly inundates the country; and six weeks after sowing his seed, the husbandman is busily occupied in storing up its produce. Such rapidity of vegetation is experienced in other countries where a long and severe winter is suddenly succeeded by a short and warm summer.

Lakes.—The mountains of Canada are numerous, but neither lofty nor arranged in extensive ridges. The lakes form a more striking feature. Three of these, from their vicinity and actual contact, may be considered as composing one body of water, for which, with propriety, the name of the Sea of Canada has been proposed. Of these, lake Superior is said to be 1500 miles in circumference, lake Huron from 900 to 1000; and lake Michigan is reckoned 260 miles long and upwards of 50 broad. They are navigable for ships of any burden, and the water is clear and wholesome; but the storms to which

North America.

they are subject are found no less dangerous than those of the ocean. To the east of these are lakes Erie and Ontario, united by the river Niagara, celebrated for the most magnificent cataract of which we have any correct information. Lake Winipec, to the north-west of lake Superior, is said to be 250 miles long and perhaps half the breadth; and farther towards the north is a still larger lake, called Slave lake, recently discovered. There are probably more than a hundred besides, many of which would be considered of great magnitude in any other country.

Population.—The population of the two Canadas, in 1784, exceeded 120,000, exclusive of savages; and since that period is understood to have considerably increased. The religion most prevalent, and indeed it may be said to be established among them, is the Roman catholic, this country having been colonized by the French, from whom it was obtained by conquest in 1763; but all other religions enjoy unlimited toleration. Since 1791, the political constitution of Canada has borne a near resemblance to that of England, and the laws are almost the same. A legislative council, consisting of fifteen members, for Lower Canada, and seven for the other province, summoned by the king, and appointed for life, under certain conditions, and an assembly of fifty persons returned by the freeholders of Lower Canada, and sixteen by those of Upper Canada, are obviously copied from our Houses of Lords and Commons. Like them they have power to make laws, but the governor-general, who is also commander-in-chief of the army, must give his sanction to their adoption; and, after all, it is competent to the king of Great Britain to declare his dissent within two years from the time of receiving any bill.

Trade.—The commerce of this country has rapidly increased since its connexion with Britain. Before that period the exports were valued at L.80,000 Sterling; in 1769 at L.163,000, employing 70 vessels; in 1795, the trade employed 128 vessels, amounting nearly to 20,000 tons, and navigated by upwards of 1000 seamen; in 1802, the exports, which were principally of grain, employed 211 vessels, of about 36,000 tons, navigated by 1850 seamen; and in 1810, the exports employed 661 vessels, and were valued at L.2,358,000 Sterling; while the imports only amounted to L. 972,837 Sterling. The exports were chiefly of provisions, lumber, furs, ashes, and some drugs; the imports were mostly articles of luxury, or such as have become necessary in consequence of certain habits acquired in the progress of national refinement. This growing commercial prosperity, it is certain, implies the internal improvement of the colony; but there is reason to doubt, when all the expenses and hazards of administration and protection are taken into account, whether Great Britain derives any essential advantage from the sovereignty. The question, however, demands very complete information, and the exercise of much discernment; and after all, perhaps, there is a feeling of national pride engaged in the maintenance of the possession, which would set at defiance the calculations of sound policy. Neither the taste nor the habits of the Canadians, we may observe, seem to offer encouragement for a union with their republican neighbours; and, on the other hand, it is impossible not to conceive the probability of some circumstance of disagreement or temptation occurring, in course of time, to give them the wish for independence. But as yet, we may add, both in point of spirit and of information, to say nothing of means, these people are at least a century behind any of the nations most interested in their political attachment.

Towns, &c.—The principal towns in Canada are Quebec, the capital, on the north-west side of the St Lawrence, a fortified and well built city, containing above 10,000 inhabitants; Montreal, an extremely neat and pleasantly situate town, about 150 miles south-west of Quebec, and nearly as large; York, the new capital of Upper Canada, situate on lake Ontario, near a long peninsula, which forms a bason capable of containing a large fleet; and Kingston, on the north shóre of the St Lawrence, near the same lake. A great number of other towns, and many villages rising into consequence, are at once the cause and the effect of extended trade and manufactures. The character of the Canadians has been variously represented, as the describers were attached to English or French manners; and hence, unless some standard be agreed on, it is impossible to do it justice. We deprecate, for our own part, all partial reports of national features. But a statement of facts must ever compel some degree of regard. Of these we select for notice, the prevalence, or, at least, very common use of the French language, a predilection for gay amusements, very sparing attention to intellectual studies, the superiority of the women in matters of even ordinary education, and the existence of a very large portion of superstition. With respect to some of these points, it is worthy of remark, the British government has exhibited a singular instance of liberality, in affording encouragement to the society of Jesuits established in this country, for some years after every European court had concurred in the destruction of the order, and now maintaining a seminary for the education of Roman Catholic ecclesiastics, by a tax, of the nature of tythes, levied on the inhabitants. Mr Heriot, from whose Travels in Canada we learn this fact, apprises us at the same time of the extension of the benefits of this establishment: "Since the decline and extinction of the order of Jesuits, the seminary, which was at first exclusively designed for the education of priests, and, excepting the college of Montreal, is the only public establishment of the kind in the province, is now open to all young men of the Catholic faith, although they may not be destined for the sacerdotal function." The clergy of the church of Rome established in Canada are, two bishops, three vicars-general, and 116 curates; while that of the church of England amounts to no more than 12 persons.

III. The United States.

The obvious inconsistency which often appears between the political and the natural boundaries of countries is scarcely separable from those vicissitudes of fortune to which nations as well as individuals are exposed. Hence the necessity for frequently revis-

United States.

ing geographical descriptions, and of restricting them to some well known period. A line, partly imaginary, cuts off the British possessions towards the mouth of the river St Lawrence, and another line still more arbitrary, in the parallel of 31°, is supposed to divide those of Spain, viz. East and West Florida, from the United States in the south; while, by cessions not properly understood, and by actual encroachments, these politic republicans have lately obtained footing in Louisiana, on the west of the Mississippi, and are gradually extending their influence across the whole of this northern continent. The particulars of the boundaries, now in a general way alluded to, will be found in Morse's American Geography, to which we must refer for minute information. The territory of the United States, about 1793, contained, by computation, a million of square miles, or 640,000,000 acres, of which 589,000,000 are estimated to be land, and the remainder, or 51,000,000 water. This, however, was exclusive of Louisiana, and since that period there has been a gradual accumulation of country in the interior, or what has been called the western territory. The extent may be stated at 1300 British miles from east to west, towards the northern boundary, and 1000 miles from the lakes of Canada to the limit of Florida on the south. This extensive region presents a very diversified appearance, and possesses great varieties of climate and soil. Some tracts are mountainous, others exhibit immense plains; lakes and rivers are numerous, and there are frequent alternations of rocky districts and rich loamy grounds. Here it may be proper to notice some circumstances which have given rise to several opinions as to the former condition of this country, and to the conviction of many persons that the whole of it, excepting the summits of the hills, was at one period under the waters of the ocean, from which it has gradually or suddenly arisen in consequence of the operation of unknown causes.

Throughout the southern portions of this region, marine shells and substances peculiar to the sea shore, are almost constantly found in large quantities, on digging to the depth of 18 or 20 feet below the surface of the earth. Of this there is a remarkable example on the banks of the Savannah, 90 miles from the sea. In sinking wells in the same places, though at the distance of many miles from the sea, the water first found is sweet and good; but what comes up when the digging is carried on a few feet deeper is so brackish as to be unfit for drinking, and the appearance and smell of the earth resemble those of the mould on the edges of salt marshes. Ridges of sand are frequently found on the margins of rivers, seeming to have been drifted there by the force of water. At the bottom of the banks of some of these rivers, trunks, branches, and leaves of trees have been met with at a depth of 15 or more feet from the surface. These sometimes alternate with layers of sand. Such appearances are known to be presented at the distance of 80 and 100 miles from the sea. The rivers, especially in the south, have often changed their channels; swamps, and grounds which lie low, are constantly filling up, and in many places the land has made great encroachments on the ocean. Dr Morse states, that in the year 1771, at Cape Lookout, in lat. 34° 50′, there was a harbour capable of receiving a hundred sail of ships at a time, in a good depth of water, which is now completely filled up and become solid ground; and such instances, he says, are frequent along the coast. Connected with this curious observation, we ought to add, that there is a gradual descent of about 800 feet, by measurement, from the foot of the mountains to the sea mark, and that it appears to extend still farther into the sea, as has been discovered by successive soundings.

Mountains.—The principal ridge of mountains of this country, to which, from its position, the quaint title of the back-bone of the United States has been given, is better known under another name, the Alleghany mountains. It is merely a part of a series of mountains of the same name, and sometimes called Appallachian, and which lie in a manner intermediate between the ocean on one side and the Mississippi and lakes of Canada on the other. Great part of these elevated regions is incapable of cultivation, but extensive tracts are also to be seen which are noted for arable and grazing land. The hills on the north of the United States, which form in part the separation from the British possessions, give rise to several rivers, some of which run towards the St Lawrence, and others find their way to the Atlantic. A similar distribution takes place farther to the south. But we remark only at present, that, in respect of being well watered, and possessing conveniences for inland navigation, this country may rival any part of the world. If, in addition to those advantages, the number and excellence of the bays and harbours on the sea coast be taken into account, the United States may rank among the most highly favoured of commercial nations.

Climate.—The sudden transitions of temperature, and the great range to which it is liable, render the climate, on the whole, unfriendly to delicate constitutions. But there are many agreeable exceptions, especially towards the south, where the winters are mild. There can be no doubt, that the rapid cultivation of the country which has taken place in recent times, has materially moderated the climate, and still greater improvements may be expected. In general, the seasons correspond as to time with those experienced in Europe, but they are not so steady. The particular direction of the wind is known to have astonishing effects on the weather; but this too is different in different places.

Soil, &c.—The diversities of soil in the United States are, of course, friendly to variety of vegetable productions. Indian corn, a native of America, is found in all the latitudes between the equator and 45° N. but thrives best between 30° and 4°. Rice, which is not a native, is successfully cultivated in some of the southern states. What is known by the name of wild rice is abundant in the interior, and, according to Dr Morse, is the most valuable of all the spontaneous productions. It resembles oats in its stalk, ear, and manner of growth, requires a rich alluvial soil, and yields a bland sweet nutriment. The common European grains are generally cultivated, and there are some others less known. Other roots and garden stuffs thrive in the greatest luxuriance and variety. Fruits of the choicest kinds, and many aromatic substances, are copiously distributed. Medical plants abound. The forests still provide ample store of timber, adapted to every common purpose. In what may be called botanical curiosities, there are few countries which can compare with the United States.

Animals.—The domesticated animals are much the same with those of Europe; and among the wild beasts may be mentioned elks, and varieties of deer, bears, wolves, racoons, beavers, the skunk, the opossum, the porcupine, wild cat, panther, &c. Some of these are unknown in the Old World, but not a few are common to both hemispheres. The list of birds and of insects is very extensive. Forty kinds of serpents, of which the rattlesnake may be considered the most formidable, have been enumerated. The rivers are well supplied with fish. Frogs of great size, and capable of great powers of voice, swarm in some of the marshy places; and alligators are not rare, especially in the south.

Minerals.—The mineralogy of the United States has not been accurately or widely explored. In a few places, some of the precious metals are sparingly found; copper is occasionally met with; lead and iron exist in abundance; and some of the other metals are frequently discovered. Coal is not so plentiful as to render it unnecessary to have recourse to foreign countries for supply.

Population.—The population of the United States, in 1790, was estimated at 3,930,000, exclusive of about 20,000 to the north-west of the Ohio. In 1801, the date of the last census, the number, including the inhabitants of the Ohio territory, amounted to 5,260,463, of which the slaves formed 894,452. This was exclusive of the inhabitants of Louisiana, computed to be 42,375. By the same rate of increase, or according to the opinion generally adopted, that the population of the United States doubles in 20 years, the number of inhabitants may now (1816) be estimated at 9,000,000. The bulk of this population, it is well known, is the offspring of persons who emigrated at various periods from the British islands; and the language still used by them is that of the parent country. The exceptions are the descendants of Germans, French, Dutch, and Swedes, whom different motives induced to seek an asylum in the uncultivated tracts of this inviting country.

Natural Division.—According to Volney, there are three great natural divisions of the country comprehended under the name of the United States. The first portion lies between the coast of the Atlantic ocean and the Alleghany mountains; the second is that which is covered by these mountains; and the third extends to the westward in the direction of the Mississippi. This division is undoubtedly natural, and for the purposes of physical geography may justly be preferred to any other; but the common division is into Northern, Middle, and Southern States.

Northern States.—The Northern States, often called New England, consist of the *District of Main*, *Vermont*, *New Hampshire*, *Massachusetts*, *Connecticut*, and *Rhode Island*. The general boundaries of this assemblage are, Canada on the north; Nova Scotia, in its largest acceptation, and the Atlantic on the east or north-east; the Atlantic and Long Island sound on the south and south-east; and the state of New York on the west.

Surface of the country.—This country presents a beautifully variegated appearance, having all the changes of hills, vallies, forests, rivers, and cultivated tracts, which are necessary for picturesque effect. The mountains are not of great height, but are very numerous, and often run in parallel lines nearly north and south. From these issue rivers and streams at very short intervals, so as to water and fertilize every part of the land. Some remains of merely natural scenery contrast finely with the comfortable indications of human labour.

Character of the Inhabitants.—An abundance of most kinds of useful grains, excellent fruits, and pasturage, rewards the industry of the numerous and intelligent population; altogether, indeed, the bounties of nature, and the effects of civilization, seem so well proportioned to each other, and to be enjoyed in so high a degree, that New England has become an object of universal admiration. Is it to be wondered at that the people themselves are alive to the same impression, and are more earnest in expressing its existence? Nothing but envy, we apprehend, could censure their habit of thinking themselves the happiest and most rationally free of the human race. But to this disposition they add a failing, apparently at variance with it, but, in fact, its almost essential companion. This we shall state in the words of Dr Morse, who is not likely to be thought either defective in information, or inclined to make it subservient to any malicious purpose: "A very considerable part of the people have either too little or too much learning to make peaceable subjects. They know enough, however, to think they know a great deal, when, in fact, they know but little. Each man has his independent system of politics; and each assumes a dictatorial office. Hence originates that restless, litigious, complaining spirit, which forms a dark shade in the character of New Englandmen." "This litigious temper, (he continues, with, perhaps doubtful accuracy,) is the genuine spirit of republicanism; but it denotes a corruption of virtue, which is one of its essential principles." The whole picture which this gentleman has drawn, deserves to be commended to the reader's notice. Every religion is alike free in New England; and no peculiar profession of any is either an advantage or a disqualification in respect to public situation. Learning and the fine arts are encouraged by the institution of universities, schools, academies, &c. and by the general regard of the people, who hold ignorance in contempt. The importance and wealth of the country may be safely inferred from the number and appearance of the towns spread over it.

Towns.—Boston, in the province of Masachusetts, is the capital. It is situate on the coast, in front of a safe bay, capable of containing 500 vessels at anchor. The wharf is said to be superior to any in the United States. In 1800, this city contained about 20,000 inhabitants. Salem, which lies fifteen miles north-eastward of Boston, has not so good a harbour, but carries on a very extensive trade, and

United States.

has about 10,000 inhabitants. Worcester, about 47 miles westward of Boston, is reckoned one of the largest inland towns in New-England. Newbury-Port, Hadley, Northampton, Hatfield, Deerfield, Concord, Cambridge, all belonging to Masachusetts, are pretty considerable places.

Portsmouth, the largest town in New-Hampshire, has an admirable harbour, is well built, and pleasantly situate, and contains nearly 6000 people. Exeter, Dover, Amherst, in the same province, are not so large. In 1776, there were 165 settled townships in this state, and the number has rapidly increased since that period.

Bennington, the capital of Vermont, is a thriving town. The inhabitants of this state are chiefly emigrants from Massachusetts and Connecticut, or their descendants; and a settlement of Scotch people are almost the only foreigners in it.

In Rhode-Island, which is reckoned the "Paradise or Eden of New-England," on account of its healthy climate, great fertility, and fine women, there are, besides smaller places, Newport, a prosperous town, having an excellent harbour, and above 6000 inhabitants, and famed for one of the best fish-markets in the world; Providence, a smaller town, but thought to be still more flourishing, built on both sides of a river of the same name, and boasting of a college under a baptist president; and Bristol, 16 miles north of Newport, possessing a good harbour, and noted for its crops of onions.

Dr Morse's account of this state, we may add, presents some very strange peculiarities, not calculated on the whole to excite agreeable impressions, or very high respect towards its inhabitants.

Connecticut has a great number of towns both maritime and inland. Hartford, about 50 miles from the mouth of the river Connecticut, is a rich commercial city. Norwich, at the head of Thames river, enjoys great advantages for trade, and begins to assume consequence as a manufacturing town. New-London, near the entrance of the same river into Long-island sound, has the best harbour in the province. New-haven, at the head of a bay farther up the sound, for pleasantness of situation and salubrity of climate, is not excelled by any city in the United States. It carries on a respectable trade; and is one of those places of which there is authentic evidence that the population has doubled in periods of about 20 years.

Stratford, Lichfield, Farmington, Middleton, and several other towns, would require particular notice in a minute description of this valuable and prosperous state.

Each of the provinces of New-England now enumerated is divided into counties, and these again are subdivided into parishes, as is common, indeed, to all the states of the Union.

Middle States.—The Middle States are, *New-York*, *New-Jersey*, *Delaware*, and *Pensylvania;* to which are added, the western territories of *Ohio* and *Indiana.*

New-York, the most northerly state, is about 350 miles long and 300 broad. It is a good deal intersected by ridges of mountains and hills, covered with timber of various kinds, but has many vallies of great extent, affording good pasturage, and admitting very profitable culture, and is abundantly watered by a multiplicity of rivers and streams, of which Hudson, Mohawk, Onondago, Delaware, Susquehannah, Seneca, and Chenassee, are the chief; besides containing several lakes, some of which have a communication with lake Ontario, on the western side of the state. The climate is more temperate than that of New-England, but, on the whole, the country is not so well cultivated. This province, at one time, exhibited in a small compass the features, manners, religion, and languages, of a considerable variety of nations. But of late years a greater uniformity has taken place; and probably, in the course of a little time, a sort of national character will be assumed. The English language, by much the most extensively used, has suffered corruption from the contiguity of Dutch and other tongues, and will require, perhaps, more serious and constant endeavours, in order to be restored to its purity, than it can be the cordial inclination of so discordant a race to bestow.

New-York, the capital of the province, and at one time the seat of the general government, is built at the mouth of Hudson's-river, where there is a large commodious harbour. It is the most commercial city in the United States, and is said to contain above 80,000 inhabitants, who are in general noted for their gaiety and social manners. Albany, also on the Hudson's river, 160 miles north of the capital, displays a remarkably heterogeneous collection of people, among whom, it may be observed, the peculiarities of the Dutch character are most conspicuous. Hudson, 30 miles below Albany, is said to have had the most rapid growth of any town in the United States, with the exception of Baltimore in Maryland.

The other towns in this province have scarcely attained any importance to require being noticed in this sketch. York-island, Long-island, and Staten-island, belong to New-York, and are of considerable consequence, especially Long-island, which is divided into three counties, and contains a good many little towns and villages.

New-Jersey, a small state, lies to the south-east of New-York, mostly along the coast of the Atlantic, on which there are several bays. Its western boundary is the Delaware, by which it is separated from Pensylvania. In length it may be reckoned 160 miles, and in breadth 52 miles, containing about 8320 square miles. The climate resembles that of New-York, and the country is similarly diversified with hills and vallies, but not in such extensive tracts as in that state. The chief range of hills is about 600 feet above the level of the sea; and much of the soil towards the coast is sandy, having the appearance of maritime origin. The rivers are numerous, though not large; but the Hudson on the north-east, and the Delaware on the west, secure an extensive trade with the capitals of New-York and Pensylvania, beyond which the inhabitants seem not very desirous of urging acquaintance. They are a very mixed race, and still retain distinct evi-

United States.

dences of their respective origins. Certain peculiarities, too, are said to result from the circumstance of their commercial connexions. Hence the people in the western part of the state, who trade with the capital of Pensylvania, assume the fashions and manners of that place; and those, again, on the eastern side, are regulated, for a like reason, by the maxims prevalent in New-York.

All sorts of religious sects are to be met with here; but the Quakers, Baptists, and Episcopalians are most numerous. Great regard is shewn in New Jersy to the cultivation of learning; and accordingly there are two colleges in it, well endowed, besides many respectable academies and schools. Out of a number of small towns in this state it is difficult to select any meriting peculiar distinction, so close is their resemblance in size and consequence. Trenton seems to be the largest. It is situate on the north-east side of the river Delaware, and is a place of some trade. Burlington, on the same river, but nearer the mouth, is a neat thriving town. Perth Amboy, Brunswick, Newark, and Shrewsbury, are places gradually acquiring consequence.

Delaware, to the south-west of New Jersey, is a much smaller province, consisting of low flat lands of moderate fertility, and exposed to a rather unhealthy climate. Its trade is not very extensive, and it has few places of any note. Dover is the capital, but Wilmington is the largest town.

Pensylvania stretches westward from New Jersey and part of New York, in the form of a parallelogram, about 288 miles in length from east to west, and 156 in breadth from north to south. Its north, south, and west boundaries, are constituted by arbitrary lines. The country is mountainous in the centre and towards the east, flatter on the west, is susceptible of successful cultivation, and possesses abundance of rivers and streams, to which, in great measure, must be ascribed its excellent pasturage. In point of climate it resembles Connecticut in the same parallel, but has the advantage of greater steadiness. On the whole, however, it is not very healthy, owing, it is thought, to the superabundance of moisture, which is very apt to be loaded with noxious miasmata. The proper cultivation of the lands, it is not to be doubted, will in time effect a beneficial change. The population, notwithstanding, is continually on the increase; but this is occasioned, in a great degree, by the influx of people from other countries. The inhabitants, in general, are the descendents of emigrants from the British islands and Germany, and are estimable for their patient industry and sober habits, allied, however, very often, it must be mentioned, with a contracted parsimonious disposition, and a kind of uncourteous reserve. The religion of the greatest part is that of the Friends or Quakers; but all other sects are alike in possession of the most perfect freedom. It will readily be admitted then, that contrasts, amounting almost to a ludicrous extent, are not unfrequently exhibited among this motley people.

To the honour of this province, it ought to be mentioned, that there are more numerous and flourishing societies for literary and humane purposes than in any of the other states.

Philadelphia, the capital, is built according to a regular plan, on a flat between the Schuylkill and Delaware rivers, but it has not been completely executed. The number of inhabitants in 1800, was reckoned at about 50,000, and it is supposed to be on the increase. They are not thought to be remarkable for hospitality, or the qualifications usually looked for in ordinary social companions; but in regard to all kinds of mercantile concerns, and in zealous well directed exertions to promote some of the most essential interests of mankind, Philadelphia may not scruple to compare with any city in the world.

Lancaster, 66 miles north-west of Philadelphia, is reckoned one of the largest inland towns in the United States. The Moravian brethren, as they are called, have several settlements in this province.

The western territory of *Ohio* and *Indiana*, reckoned with the middle states, is much more connected as to position with Virginia, one of the southern states. Hitherto it is but sparingly cultivated, and does not present any topic requiring our immediate attention.

Southern States.—The Southern States, which alone remain to be mentioned, are *Maryland*, *Virginia*, *North Carolina*, *South Carolina*, *Kentucky*, *Tenassee*, and *Georgia*.

Maryland is bounded on the north by Pensylvania, on the east by the state of Delaware, on the south-east and south by the Atlantic, and on the south-west and west by Virginia. It is 134 miles long and 110 broad, containing about 14,000 square miles, a sixth part of which is water. The climate is mild, and in the hilly part of the country healthy; but the marshes and stagnant waters of the flat country subject the inhabitants to intermittent fevers. Chesapeake bay, which is the largest bay in the United States, divides this country into two portions, the eastern and the western. The state has several rivers. Wheat and tobacco are the staple commodities of Maryland; and, in the interior, hemp and flax are raised in considerable quantities.

The inhabitants, who are chiefly of the Roman Catholic religion, live commonly on their plantations, at several miles distance from each other, and are represented as rather indolent and slovenly. But there are many exceptions, and some of the towns exhibit a very enterprising community. The chief towns are, Baltimore, reckoned the fourth in size and the fifth in trade in the United States; Annapolis, said to be the wealthiest town of its size, situate about 30 miles south of Baltimore; Fredericktown, a thriving inland place; and Hagarstown, little inferior to it.

On a neck of land, ceded by Virginia and Maryland to the United States, the foundation is laid for the seat of government, denominated, in honour of a character immortalised in the history of America, and indeed of the human race, as one of its greatest ornaments. This city of Washington, already far advanced, on a regular and beautiful plan, promises, when finished, to be one of the finest cities in the world, and appears to be in possession of certain local advantages, which, independent of political considerations, will go far to ensure its continued prosperity.

Virginia, bounded on the east by the Atlantic, on the north by Pensylvania and the Ohio, on the west by Kentucky, and on the south by North Carolina,

United States.

is about 400 miles long, and upwards of 200 broad. It is divided by the Potomack, Rapahannock, York, and James rivers, has a healthy climate, subject however to great heats, and possesses a fertile soil, especially on the flat lands. The staple commodity is tobacco; but the country, with proper treatment, is capable of producing all the necessaries, and many of the luxuries of life.

This state has produced some of the chief characters in the history of United America, but the people in general are not supposed to concern themseves much with political affairs. A few persons, it is remarked by Dr Morse, appear to have obtained, and continue to exercise a sort of ruling influence over the majority; and thus their government, though nominally republican, is, in fact, oligarchical, or aristocratical. Hospitality bordering on ostentation, a liveliness of manners degenerating into licentiousness, an attachment to pleasures scarcely susceptible of check from the clearest conviction of its ruinous consequences, and a sort of national pride which rather seeks for indulgence in the memory of past times than prompts to excel them by new and nobler efforts, render the Virginians a people more interesting than amiable, and yet more amiable than worthy of respect.

Richmond, built on the north side of James river, is the capital; but it is neither very elegant nor very populous. Norfolk is the principal port in this state. The other towns are in general small, but some of them promise rather rapid augmentation. The population of Virginia is probably not much short of one million.

North Carolina lies to the south of Virginia, having the Atlantic on the east, Tenassee on the west, and South Carolina on the south. It is about 400 miles long and 110 broad, and, in 1810, the population exceeded 563,000 souls. It possesses a mild climate; the heat of summer is moderated by agreeable breezes, and the cold of winter is chiefly confined to the evenings and mornings. In some parts of the country, owing to the flatness and moisture of the lands, diseases of debility are not rare in the warm months; but still more frequent are inflammatory complaints during the winter, occasioned, it is believed, by intemperate habits, too common in this state, and by incautious exposure to the weather. The soil is generally good, answering for tobacco, and productive of a vast variety of trees, grains, herbage, medicinal plants and roots, &c. A particular species of pine, affording pitch, tar, turpentine, lumber, &c. constitutes at least one half of the exports of this state, and may be called, therefore, its staple commodity. Most of the towns are small, and built of wood; and none of the rivers by which this state is watered will admit vessels of more than 80 tons burthen.

South Carolina, in many respects, resembles North Carolina, with which it was at one time united. Its position is similar, partly on the sea coast, and partly stretching inland to the western territories. It is about 300 miles long and 125 broad; its population, which is rapidly on the increase, was 240,000 in 1791. Much of the country is flat and low; and as it is frequently overflowed with water, for the sake of cultivating rice, a prime article in this state, the air is loaded with moisture and becomes unhealthy. There are four navigable rivers in South Carolina, besides many small streams. The vegetable products are much the same as in the northern state. Charlestown, the only considerable town in South Carolina, at the confluence of Ashley and Cooper rivers, on a piece of flat land, is regularly built and fortified, and possesses a commerce inferior in amount only to New York, Philadelphia, and Boston. Its inhabitants, reckoned in 1791 to be 16,359, are respected throughout the whole of the United States, for their hospitable, kind disposition, and the unaffected but elegant simplicity and ease of their manners and address. The Carolinians in general are entitled to such commendation, but it is impossible to bestow it without feeling regret that there should be any drawback to compel animadversion. The employment of slaves, which is common to the southern states, seems to have engendered a haughtiness of behaviour among the *better* kind of people, and to have fostered an indolently luxurious disposition, by no means favourable either to the happiness of the individual possessors or the welfare of the community.

Barbarous amusement.—To what perversity of feeling, or worse than brutal taste, must we ascribe the prevalence, in the Carolinas and Georgia, of a species of amusement in which the parties, engaged seriously, endeavour to put out one another's eyes? None of our readers, we are convinced, can peruse a recital of the mode by which this feat is accomplished, without experiencing unutterable horror and indignation. Dr Morse, whose description we shall quote, speaks of it as if it were confined to the lower orders of people; but this does not exculpate the government from indifference to the shocking enormity. Besides, if we reason from what is known of the satisfaction and readiness with which, in other countries boasting of their humanity, many persons of the higher orders bring themselves to sanction the cruel propensities of the vulgar, we shall not hesitate, independent of other evidence of a positive nature, to believe that more are gratified by the spectacle than can be furnished with a shadow of excuse against the charge of being as savage as they are either poor or ignorant. "The *delicate* and *entertaining* diversion, with propriety called *gouging*, is thus performed. When two *boxers* are wearied with fighting and bruising each other, they come, as it is called, to *close quarters*, and each endeavours to twist his fore-fingers in the ear-locks of his antagonist. When these are fast clenched, the thumbs are extended each way to the nose, and the eyes *gently* turned out of their sockets. The victor, for his expertness, receives shouts of applause from the sportive throng, while his poor *eyeless* antagonist is laughed at for his misfortune." Mr Janson, who has published an account of his observations during a considerable residence in America, bears testimony to the accuracy of this statement, from his having once been present at the barbarous sport. "Passing, in company with other travellers," says he, "through the state of Georgia, our attention was arrested by a gouging match. We found the combatants, as Morse describes, fast clenched by the hair, and their thumbs endeavouring to force a passage into each other's eyes; while several of the bystanders were betting upon the first

United States.

eye to be turned out of the socket. For some time the combatants avoided the *thumb-stroke* with dexterity. At length they fell to the ground, and in an instant the uppermost sprung up with his antagonist's eye in his hand. The savage crowd applauded, while, sick with horror, we galloped away from the infernal scene." We would not conclude this subject, however, without expressing our belief, that such diabolical practices are less frequent than formerly, and our hope, founded on the almost certain effect of the universal detestation excited against it in the civilized world, that in a little time the feelings of humanity will no more be outraged by proofs of its commission.

Georgia, lying to the south of Carolina, and bounded on the east by the Atlantic, on the west by the Mississippi, and on the south by Florida, is reckoned 600 miles in length from east to west, and 250 in breadth from north to south. It is healthy in the hilly country, where the climate is pretty uniform and temperate, but in the flat lands, the warm, moist air, often loaded with putrid effluvia from the marshes, is injurious to the constitution, and together with the nature of the water, which is generally brackish, brings on bilious and intermittent fevers during the summer, and these again are liable to be succeeded by pleurisies and other inflammatory complaints in the winter months. The face of the country, and most of the productions of the soil, resemble or are the same as those in South Carolina. Industry and proper management seem all that are required, both to augment the salubrity of this country, and to render it the vineyard of the United States.

The rapidity with which population has increased of late years, can scarcely be accounted for without supposing a great influx of persons from other regions, who must consequently have had a flattering opinion of its capabilities, and in reality be confirmed in it by experience. According to Dr Morse, the emigrations from Europe, the Northern States, and the back parts of Virginia and the Carolinas, were so great immediately after the peace of 1783, as more than to triple the number of inhabitants in the short space of six years. In 1791, the population was estimated to be 82,548; and in 1810 at 252,433; a difference which we believe to be unparalleled in the history of any other country.

There are several rivers in this state, of which the Savannah is the most noted; and about 60 miles to the south of its northern boundary, the Alleghany, or Appallachian mountains, terminate in an extensive plain, covered with a soil of great fertility, and said to be suitable to most of the productions of the East Indies.

The chief towns are, Savannah, Louisville, Augusta, Brunswick, and Frederica; and on the coast are some useful islands, as, Skidaway, Wassaw, Ossabaw, &c.

Great efforts have been made to promote literature and the useful arts in Georgia, though still in its infancy. The interests of religion also have not been defrauded of the regard due to their importance.

Kentucky and Tenassee, the only states which remain to be noticed, are recent acquisitions to the union, and hitherto have been but imperfectly cultivated and described. The former, properly speaking, is the back-settlement of Virginia, and the latter that of North Carolina, to which states respectively they bear some resemblance in point of soil, climate, and natural productions. Kentucky is farthest advanced in population, reckoned at no less than 406,511 in 1810, and in the number and size of its towns, of which Lexington, situate about 60 miles south-east from the conflux of the Kentucky river with the Ohio, is the chief.

Tenassee, which is to the south of Kentucky, having the Mississippi for its western boundary, the states of South Carolina and Georgia on the south, and North Carolina on the east, is a very extensive tract of land, with a fertile soil, and a climate of superior mildness and salubrity. The population which, in 1795, amounted to nearly 80,000, is on the increase, and may be expected to receive vast accessions from without, when the native tribes, who prove occasionally troublesome, and sometimes destructive, in all the western territories, are either entirely brought to subjection, or can be induced to maintain a permanent and secure alliance. Knoxville is the capital of Tenassee, a small but thriving town, built of wood.

We may here take a cursory glance of a region which is at present under the dominion of the Spanish nation, but which has often changed masters.

Florida, the country now alluded to, is bounded on the north by Georgia, on the east by the Atlantic ocean, on the west by the river Mississippi, and on the south by the gulf of Mexico. In length, from east to west, it is reckoned to be from 500 to 600 miles, and from 100 to 400 miles in breadth from north to south; the greatest extent in this direction being at the eastern side, where a considerable projection into the ocean forms an inclosing bank to the Mexican gulf.

Florida is divided into West and East by the river Appalachicola, which flows into St George's sound, the river St Mary and an imaginary line separating both from the territories of the United States. The climate throughout is very like that of Georgia, and as to soil this region is no less various than that state. The eastern parts are less fertile; yet even in them it is common to have two crops of Indian corn in the year. Fruits and vegetables of many species are also abundant, and some parts of the country are peculiarly valuable as ranges for cattle. Of the amount of the population, and many other interesting subjects respecting this country, we have had but scanty information since it has been in the hands of a people noted for their silence and cautious reserve on subjects of general policy. Pensacola, the chief town in West Florida, stands on a bay forming a commodious harbour, where vessels may ride secure from every wind. St Augustine, on the coast of the Atlantic, a fortified town, of an oblong figure, inclosed with a ditch, is the capital of East Florida.

American Revolution.—A relation of the most important circumstances which eventually led to the separation of the United States from the British do-

United States.

minion, and their establishment as an independent power, naturally follows the description which we have now given. In the following sketch, by retracing the history of these regions somewhat farther than at first sight may seem necessary, we shall, perhaps, discover a striking connexion between some remoter transactions, comparatively of a trifling nature, and others, which, both because they are more recent, and of greater visible magnitude, have attracted a larger share of attention.

Grants of lands.—All the Europeans who successively visited America in the progress of its discovery, agreed in this, that they had *a right* to possess themselves of such places as were not previously seized on or occupied by other Europeans. The kings of England, France, Spain, &c. made grants of lands to their subjects, as if they had acquired the sovereignty of them in the common course of patrimonial inheritance, and apparently without any apprehension of injustice or informality, saving what might arise from the circumstance of similar grants having been previously executed. Some difficulties in adjusting the terms of these deeds, or putting them into operation, were occasionally experienced, in consequence of ignorance of prior deeds, cotemporaneous discovery, or former abandonment by other powers. These difficulties were insignificant in many instances, because the disputed lands being unproductive, or requiring both time and expence for their improvement, did not hold out a reasonable ground for jealousy, far less a justifiable cause for animosity. Very different was the case, when, in the progress of population, and the extension of commerce, these distant settlements began to re-act on the powers by which they had been formed. Old claims were then revived with pertinacious alacrity, and their validity appearing as decisive as their importance was seducing, rival nations prepared to maintain them by force of arms.

War from 1739 *to* 1748.—The war between England and Spain, in 1739, arose from a question of *right*, claimed by the subjects of the former power, to cut logwood in the bay of Campeachy, in which they were frequently interrupted and exposed to capture by the Spaniards. It was carried on with various success, and involved other continental powers, for several years. A termination was put to it by the preliminary treaty of Aix-la-Chapelle in 1748, by no means to the credit of British diplomacy, though certainly not too early for British necessities. Some conquests made in North America, particularly that of Cape Breton, were given up, and the right of navigating the American seas, without being subjected to search, which, in fact, was the original source of disagreement, was never so much as mentioned. The French, who had taken part in the contest, remained in possession of Canada, the limits of which were imperfectly adjusted; and they claimed, besides, the whole of the country on both sides of the Mississippi, and a great deal of Florida, between which and their northern settlements they had established a communication by a line of forts.

Conquest of Canada.—The peace was neither very cordial nor of long continuance. Disputes arose with the French, as might indeed have been expected, from the nature of their claims, and their offensive measures to effect a trade with America. Both powers made vigorous preparations for a renewal of hostilities, but the king of England did not publish his declaration of war till 1756, and not until he had endeavoured, by several mediatory steps, to render it unnecessary. The counter-declaration of the French monarch was expressed with unusual acrimony, and all things presaged a spirited and obstinate collision. Though ostensibly undertaken for American interests, the succeeding war was not entirely, nor indeed chiefly carried on in the New World, but affected the continent of Europe and the dominions of the contending powers in the East Indies. Of four expeditions equipped against the French in North America, during the early part of the war, three completely failed, to the great mortification of England; the operations of 1757 were, if possible, still more disastrous; the next campaign, though far from being very successful, was somewhat encouraging; the advantages gained were improved during 1759, under the brilliant administration of the elder Pitt, and by the bravery and skill of Wolfe, who terminated his short career of glory on the heights of Abraham; and, notwithstanding the utmost exertions of the French to retrieve their losses, the whole of Canada fell into the hands of their enemies during the following year. The peace of 1763 confirmed the British in the possession of that extensive region, and indeed of the whole of North America east of the Mississippi, with the exception of an inconsiderable portion of country towards the south.

Effects on the colonies.—This conquest was made at an expence vastly greater than its real value, and entailed consequences of vital importance to Britain and her transatlantic colonies. It is of these we have now briefly to treat.

The war had been commenced and prosecuted, in a great degree, with a view to the defence of those provinces which had been settled on the eastern coast of North America, and which were perpetually exposed to attacks from the French and the Indians in alliance with them, on their northern and western frontiers. It seemed reasonable that part of the burden should be borne by those whose benefit was thus intended; and accordingly the colonies were by no means backward in fulfilling requisitions for men and money, while the danger by which they were threatened prompted them to make partial sacrifices. They had previously, however, shewn an aversion to be taxed by the parent kingdom, alleging their non-representation in parliament as a reason for their exemption; and, in fact, had cautiously avoided every acknowledgment of the right of taxing on the part of the British legislature. Even the alarming condition of their affairs at the outset of a war, for which they were so ill prepared, failed to seduce them into any measures of acquiescence that might afterwards be appealed to as precedents. The monopoly of their trade, at this time very extensive and still improving, might be held, they probably thought, as an adequate compensation for any parental solicitude or assistance which they had hitherto experienced, or were likely to require. But no sooner

United States.

was the war over, than the colonies felt themselves completely disburdened, both of gratitude and danger, while, on the other hand, the financial embarrassments of the British government, which had been continually augmenting during an impolitic and mismanaged contention, instigated to the adoption of some new expedients for an increase of revenue. Nor were there wanting other causes of irritation to aggravate the unhappy discordancy that now arose, some of which alone might have alienated the weakened affections of the colonists. Their trade, for example, was shackled by the frequent interference of sea-officers, most injudiciously employed in the service of the revenue; and a gainful intercourse, which had for some time existed between them and the Spanish and French settlements in different parts of the New World, was either forbidden, under the erroneous allegation that it was injurious to the interests of the mother-country, or was so much clogged by conditions and duties as rendered it nearly altogether unprofitable. The effect of this impolitic check was so immediately visible, as, if some extraordinary delusion had not seized the British people, would have been sufficient to give warning of the evils to be derived from intermeddling in their concerns. To use the language of the times, the children now resolved to live as much as possible independent of their mother, and accordingly commenced a system of parsimony in the use of articles formerly obtained from her, and of active exertions to improve their own resources. This determination was immensely hurtful to the exports from Britain, which had about this time been estimated at three millions Sterling, not to mention the benefits accruing from the transmission of goods. There needed but a single spark to give agency to such combustible materials as henceforth accumulated in both countries, and this was not long to be sought for.

Stamp-act resisted.—In the session of 1764, the House of Commons, besides laying new duties on their foreign trade, voted, apparently without opposition, "that, towards farther defraying the necessary expenses of protecting the colonies, it may be proper to charge certain stamp-duties upon them." No measure, however, was instantly founded on this decision. The agents of the colonies, then in London, were given to understand, that proposals would be received from their principals for any other tax, in place of the one projected, that might be equivalent in produce; or that, by agreeing to it, they should in future be consulted before taxes were imposed on them by parliament. But not one of these agents was empowered to consent to such a tax, or to offer any equivalent for it. Their constituents, when apprised of such suggestions, appear in general to have considered them as insults; and some of them, in petitions addressed to parliament, directly questioned the authority which had thus been assumed over their property. It seems extraordinary, that these symptoms of refractoriness were not more seriously contemplated by the legislature, as ominous of a fatal convulsion, should the proposed treatment be carried into effect. Several members in opposition now exerted themselves against the measure; and almost every evil which afterwards followed, was predicted with the eloquence and gloomy interest of prophecy. But in vain. The ever memorable *stamp-act*, as it was called, passed on March 22. 1765, having, in consequence of his Majesty's illness, received his assent by commission.

The Americans, without altogether abandoning hope that their remonstrances would avail, were not very much surprised at this event. It had been sufficiently anticipated by them, in consequence of the previous discussions, to give rise to speculations and emotions most inimical to the act itself, and to their political connexion with the mother country. All the provinces, it is certain, were not equally irritable; so that although, by newspapers and other means, any intelligence which affected their common interests spread rapidly among them, yet it was of some relative consequence that one of them should be first apprised of the act having passed, in which less opposition might reasonably be contemplated. If choice, then, or judgment had been permitted, one of the southern provinces would no doubt have been preferred for the place of earliest communication. Unfortunately, the important tidings first of all reached New-England, in which, for reasons elsewhere assigned, there existed a strong remembrance of ancient grievances, and an apathy, if not a positive aversion towards the parent state. Angry feelings and hostile sentiments instantly broke forth; extraordinary means were resorted to for the purpose of provoking opposition; and it became perfectly evident, that every individual thought himself engaged, by invincible obligations, to exert his whole strength and influence against such presumptuous enactments. Readers of the present day cannot but be somewhat amused with the recital of the various devices, serious and comic, in which this opposition displayed itself. We shall sum them up nearly in the words of Dodsley's Annual Register, which must be allowed the merit of having early given warning of the probable catastrophe. Ships hung out their colours half-mast high, in token of the deepest mourning; the bells rang muffled; the act itself was printed with a death's-head affixed to the place where the stamp is usually placed; and this was publicly paraded through the streets, by the name of the "Folly of England, and Ruin of America." The newspapers were filled with essays and animadversions of all sorts, to spread the delirium. One of these, with a very significant title, exhibited the more significant emblem of a snake cut in pieces, each of which had one of the initial letters belonging to the names of the several colonies, from New-England to South Carolina inclusive, and having above them the words, JOIN OR DIE. Caricatures, puns, &c. &c. were added in abundance; and by being very expressive, and easily remembered, admirably served to condense, preserve, and propagate the logic and venom of the multitude. More important, because *official*, demonstrations of the same spirit afterwards appeared; and, in short, such was the determination and energy of all classes of the population, that by the 1st of November, when the act was to take effect, there was not a single sheet of stamped paper to be had throughout the colonies of New-England, New-York, New-Jersey, Pensylvania, Virginia, Maryland, and the Carolinas,

United States.

with the exception of a small parcel, which the governor of New-York had surrendered to the corporation of that town, on condition of its not being destroyed like the rest. A great deal of business was now abandoned, or became illegal, in consequence of this defect; and the governors, at last, apprehending more mischief from its cessation than the informality, pretty generally agreed to dispense with the stamps, which were thus virtually given up. But, before this time, the colonists considered themselves almost totally released from their allegiance; and by various expedients had at last discovered, what at one time would have seemed impossible, that they could exist and prosper without the partiality and produce of Britain.

The obnoxious act was repealed in the following year; a concession which of course was held as a triumph of the most gratifying kind, and which did not fail to foster the infant but strenuous efforts of the aspiring Americans. Old habits, however, besides obvious and very natural prejudices, operated in restoring a liberal commerce with the parent state, and undoubtedly might have secured a pacific, if not a cordial adherence. But Britain, not at all profiting by experience, and probably presuming on the strength of the attachment, and at all events being unwilling to abate of her pretensions, attempted again to derive an augmentation of revenue, by levying duties on various articles which the colonists had been accustomed to import. Their resentment was again excited; and again it became necessary to attempt to allay it by receding. All the duties were accordingly repealed in 1770, excepting one of threepence a pound on tea, which, however unproductive, was still adequate to keep alive the deep-rooted jealousy of the people, and, if possible, by attracting their notice to its merely significant character, to augment their hatred of taxation.

Violent opposition.—The colonies now prohibited the importation of tea, in revenge of the impositions thus laid on it. Contentions soon afterwards arose between the residentiary governors and the provincial authorities; the soldiery, of course, taking part with the one, and the people with the other. A scuffle which occurred at Boston, on 5th March 1770, produced the first blood, several persons being shot, in consequence of an imprudent order to fire on the inhabitants. An assembly, held in Massachusetts, formally disowned the supremacy of the British government. Some arbitrary and inconsiderate measures, on the part of the legislature, exasperated the discontents, already too prevalent. In a word, every thing indicated the bursting forth of a flame which could only be subdued by the complete military inundation of the colonies, or their eternal separation from Britain. One of the first acts of aggression, on the part of the Americans, was the destruction of the Gaspee, an armed schooner belonging to his Majesty, which had been stationed at Providence, in Rhode-island, to prevent smuggling, the commander of which had given great offence by his vigilance in the performance of his duty. A reward offered for the discovery of the persons engaged in this affair was ineffectual. This took place in 1773. In the same year, some of the people of Boston, having entered into three ships which had arrived with cargoes of tea belonging to the East-India Company, now employed by the government in introducing that article, threw more than three hundred chests of it into the sea. Parliament, on being informed of this offensive proceeding, resolved on an exemplary punishment, and therefore passed a bill. "to discontinue the landing and discharging, lading and shipping, of goods, wares, and merchandize at the town of Boston, or within the harbour." This was followed by another bill, for "the better regulating the government in the province of Massachuset's bay," which had in view the abstraction of the executive power from the hands of the people, and placing it in the crown.

It was now impossible for the colonists to recede, without a sacrifice of all for which they had hitherto been so resolute to contend. Alarm, detestation, and revenge, spread universally. Assemblies were held in the different provinces, in which there prevailed but one spirit, though there were various opinions as to the most eligible mode of giving it effect. A general meeting of deputies was at last agreed on, for the purpose of concerting measures of defence and relief. These accordingly were appointed; and their first Congress, as it was called, met at Philadelphia on 26th October 1774.

Commencement of hostilities.—Their proceedings would have done honour to a much older assembly, and were very different from what might have been expected as the result of that untoward exasperation which had previously operated. But their petition to the king, and their address to the people of Britain, did not prove so efficient as their exhortations to their countrymen to persevere in determinations to defend their constitutional rights. It is unnecessary to specify the events which succeeded, till the commencement of regular hostilities in 1775. Generals Gage, Howe, Burgoyne, Clinton, and Cornwallis, were the officers first employed in the service of the mother country; and George Washington, who had formerly signalised himself in the British army which had defended the colonies against the French, was appointed commander-in-chief of the American forces. This illustrious man did not take the command till the month of July in this year. A battle had been previously fought at Bunker's Hill, in which the British, though they ultimately succeeded in carrying a fortification that had been the principal motive for the attack, lost considerably more men than their opponents. But the Americans had to regret the fall of their leader, Dr Warren, who had quitted the useful and highly honourable duties of the medical profession, to answer the more hazardous demands of his country.

The scattered troops of the provincialists were rallied, disciplined, and guided by Washington, who, after repeated skirmishes, obliged General Howe to abandon Boston, into which he himself entered in triumph in the month of March 1776. In the course of this summer, a powerful force, consisting of ships under Sir Peter Parker, and of troops under Clinton and Cornwallis, was repulsed with great loss in an attack on the capital of South Carolina. Some other advantages were gained in different places by the Americans; but they were greatly overbalanced by a series of disasters, viz. their defeat on Long-island—their being forced to abandon New York—their loss of Rhode-island—the discomfiture of their northern army—the capture of General Lee, one of their best officers, &c. in consequence of all which events this year might have been said to have almost utterly destroyed their hopes of independence. Desertion and sickness thinned the remaining troops, which it was nearly madness to suppose could prevail against the well disciplined, numerous, and high spirited enemy with whom they had to contend. But the intrepid and sagacious commander, in whose talents and successful influence all chance of redemption, humanly speaking, consisted, with not more than 3000 men, so far from yielding to useless despair, ventured to renew offensive operations. He made a sudden and totally unlooked for attack on his enemy at Trenton on the Delaware, routed them, taking above 900 prisoners; and soon afterwards bore down on three regiments at Princetown, over whom he obtained another complete victory. It was in July of this same year that the congress published their declaration of independence; so that, altogether, it must ever be memorable in the annals of the American struggle.

Colonists treaty with France.—The following year was distinguished by events scarcely less remarkable, most of which were in favour of the colonists; though the defeat of Washington at Brandywine, in consequence of which Philadelphia was captured, and his discomfiture not long after at Germantown, were mortifying checks to their rejoicing. But these and other inferior losses, could not prevent, though they might retard the accomplishment of their ambition. Besides, they were amply compensated by the surrender of the whole army under General Burgoyne on the 17th October, an event which not only afforded immense relief to their still confined means, but also, by its brilliancy, and the probability of its successful effects, laid a foundation for an important treaty with France. This was concluded on the 30th of January 1778, "by which," says an American writer often referred to, "we obtained a powerful and generous ally." But the operations of this year were not very considerable, and certainly no way decisive. Sir Henry Clinton, who succeeded to the command of the British army on the departure of General Howe for England, evacuated Philadelphia and retired to New York, in his march to which place he was exposed to serious losses by attacks on his rear.

In 1779 the Spaniards acceded to the American cause, and thus Britain found herself completely occupied. The campaign was various in its bearings on the ultimate question, but still appealed to future contests.

The year 1780 was more actively employed, and seemed at one period to threaten the ruin of American expectations. Charlestown, garrisoned by an army under General Lincoln, surrendered to the British troops commanded by Clinton and Cornwallis; this last officer completely routed General Gates at Camden, in the same province, and marched through the southern states without opposition; and the treachery of one of their own generals, Arnold, to whom, in his necessary absence, Washington had committed an important post, nearly occasioned the surrender of their finest army.

Colonists finally succeed.—The battle of Guilford, which took place on 15th March 1781, between General Green, who had succeeded Gates in the command of the southern department, and Lord Cornwallis, was most destructive to the British army, though the Americans were obliged to retire from the ground on which they had so desperately fought. Cornwallis having afterwards marched to Virginia, found it necessary to fortify himself in York-town, where, being blocked up by Washington, who had slowly followed him, he was under the necessity of surrendering on 19th October, which decided the contest in favour of America, and led to the treaty of peace, the preliminary articles of which were signed at Paris on the 30th November 1782, after an embittered and obstinate conflict of seven years duration, and an expenditure on the part of Britain of nearly an hundred millions of money, and the loss of about an hundred thousand lives.

Convention of the States.—The political constitution which had bound the states together during a season of danger common to the whole, was the hasty product of their apprehensions and necessities, sufficient, indeed, while these lasted, to give the energy of combination to their separate efforts, but quite unfit for their salutary government in the relaxation and carelessness of peace. Its defects were soon experienced to be numerous and essential. Discontents, jealousies, and insurrections very generally spread, and threatened a worse condition than would have occurred under the most despotic authority. These dissensions, at last, proved so detrimental to their interests, and especially their commerce, as to require a general convention, fully empowered to deliberate on the means of procuring tranquillity, and to recommend another form of government. The convention met at Philadelphia in May 1787, when Washington, the common benefactor of his country, was chosen president. Four months were passed in discussions and inquiries, which fully disclosed the prodigious evils already existing, and pointed out others near and formidable enough to occasion the most painful solicitude. A plan of federal government, seemingly adequate to the demands of the crisis, was agreed on, and measures were consequently taken to collect the sentiments of the people as to its adoption. It may be interesting to most readers to mention the result.

The small state of Delaware, after a few days consultation, ratified the constitution without a dissenting voice. Pensylvania displayed a very spirited opposition; but two-thirds agreed to the plan, and the dissentients gradually lost ground. New Jersey and Georgia were unanimous for the adoption. Connecticut had a small minority against the plan, which soon subsided. In Massachusetts the opposition was great and respectable, and five weeks were occupied in debates on the subject, when there appeared but a small majority for the constitution; to the honour, however, of the minority, be it mentioned, that on seeing the decision, they submitted with alacrity, and united

United States.

in support of the government. In New Hampshire the question remained a considerable time in suspense, occasioned, it seems, by some want of information; an adjournment was therefore made, and afterwards there appeared a respectable majority for the plan. Maryland was somewhat distracted by the arguments of certain able men, who opposed the measure, but it was eventually carried by five-sixths of the voices. South Carolina had two-thirds in favour of the proposition. Virginia carried it by a small number. New York exhibited an interesting scene, no less than two-thirds of the delegates being determined to reject the constitution; the debates were long and able, but as, during the session, the congress found itself empowered to organize the new government, the expediency of uniting with the rest of the states, and other reasons, induced the meeting, by a small majority, to accept of the plan. The case was different in North Carolina, which, for reasons not well known, rejected the constitution. Lastly, Rhode-island, by a perverse and singular policy, in place of calling a convention of delegates, as the other states had done, took the sense of the people in town-meetings, in which, on the whole, there appeared a majority against the plan. The public mind had been agitated in a remarkable manner; when nine of the states agreed the suspense was allayed, but considerable anxiety remained till Virginia and New York were known to have acceded. After this the general joy was excessive, and displayed itself in every method which ingenuity, gratitude, and hope, could devise to commemorate so propitious an event.

It is a circumstance not commonly known, that a federal representative government was planned by the American colonists so early as 1754, in a congress held at Albany. This, according to Governor Pownal, from whose "Memorial," (1803,) we learn the fact, was the first display of those "speculations in philosophy and inexperienced visions in politics," which ultimately occasioned the revolutionary state of Europe. However this may be, and undoubtedly it has a semblance of truth, it is still more certain that the conduct and fortune of the Americans had no mean influence on the disorganization of the French monarchy. But it is not to our purpose to do any thing more than merely hint at this interesting topic; and to some readers, perhaps, it may not be ill-timed to suggest, that there is a natural and almost invincible tendency in all colonies, whatever be its origin, to become independent of their parent stock. This, then, being admitted as physically or morally true, and as proceeding from causes which no political sagacity can obviate, it seems absurd to regret an event, which, essentially connected as it is with principles established in the method of providence for the government of the world, must be held, on the supposition of there being inherent goodness in that government, as necessarily productive of ultimate benefit. Whether the period has yet arrived at which the full amount of such profitable tendency could be realized, may certainly be doubted; but it appears not impossible to ascertain the existence of some advantages fairly imputable to the transactions we have been considering. It seems extremely probable, that the establishment of political freedom on the part of the American colonies, has proved more salutary to Britain than their continued and augmented dependency would have been. To give this probable supposition all the force of certainty, two facts, which are of no small moment, need only be referred to, namely, the prodigious extension of her commerce after that event, and the attainment of a power and resources, which, in defiance of greater hostile combinations than she had ever before encountered, and in the midst of convulsions that spared not a neighbour to congratulate her escape, preserved the sacred deposit of civil liberty and legitimate authority for the renovated world.

New Constitution.—The chief peculiarities of the new constitution thus adopted by the States may be summarily stated, and indeed require to be so for the due understanding of the nature of that singular government, to which, with all its imperfections, the Americans are indebted for their increasing consequence as a nation. The legislative power was vested in a congress, consisting of a senate and a house of representatives. The executive power was vested in a president, who, as well as a vice-president, was to hold his office for four years. The judicial power was vested in one supreme court, and such inferior courts as congress might appoint; the judges of the whole retaining their offices during their good behaviour, and receiving a compensation for their services without abatement, while continuing in office. Every state was to give full faith and credit to the public acts, records, and judicial proceedings of every other state, the congress being empowered by general laws, to prescribe the manner in which such acts, &c. should be proved. The congress, at the voice of two-thirds of the members of both houses, might propose alterations and amendments of the constitution or might call a general convention, for effecting such, if required to do so by the legislature of two-thirds of the several states; the decisions in either case being binding, when ratified by three-fourths of the members. The ratification of the convention by nine states was to be held sufficient for the establishment of the constitution between the states so ratifying. The members of the senate, or superior council, viz. two from each state, were to be chosen every six years; whereas, the house of representatives, which was not to contain more than 200 members, each of them representing from 33,000 to 50,000 inhabitants, was to be elected every second year. The president was to have the command of the army and navy, to make treaties with the consent of two-thirds of the senators, and to have the power of pardoning criminals, except in the case of impeachment. Sundry articles were occasionally added to the original draught of the constitution, and several objects are provided for and guarded against by specific regulations.

Political parties.—The first congress, according to the new constitution, met at New York in 1789. Its first measure was the highest expression of the general opinion of the supereminent services, talents, and influence, of the late Commander-in-chief, who, with a rare display of moderation, had resigned his power, and betaken himself to the enjoyment of

United States.

domestic repose, but who was now called upon, unanimously and urgently, to give dignity and firmness to the constitution, by accepting its most important trust. It is clear that there was no affectation in the reluctance with which Washington acquiesced in this honourable summons; and that he prepared, with self-denial and some painful feelings, to discharge the duties which such distinction enjoined. His arrival at New York was signalized by the most gratifying tributes of affection and confidence; and, for some time, his parental authority, sweetened as it was by the amiableness and simplicity of his personal deportment, allayed that party spirit, and those discordant emotions which had already disturbed the union. The chief feature of the political differences which now existed, and which have continued with little abatement to the present time, is recognised in the names of *Federalist* and *Anti-federalist*, so well known in the history of these states. Like many other terms commonly applied to political antagonists, these words do not accurately designate the ground of contention, and are liable to variation of meaning, according to the unavoidable changes of human affairs. In general, the former is understood to denote those persons who have a partiality towards a government of a monarchical nature, or at least one which, with some of the characteristics of monarchy, embraces the real, though perhaps not the nominal distinctions of an aristocracy; whereas the latter term is applied to those whose opinions are more congenial with the principles of a democracy, or a simple republic. Much of the remaining portion of the history of the United States is made up of the animosities and altercations of these two parties, and of the consequences with respect to other nations to which they gave rise.

Effects of the French Revolution on the American States.—Washington, though in sentiment a Federalist, was careful to avoid any display of his partiality, and actually chose a gentleman, Mr Jefferson, for the department of foreign affairs, who was admitted to be the head of the Anti-federalist opposition, but whose talents and character, in the judgment of that excellent man, were calculated to benefit his country. Such candour merited the cordial imitation of the controvertists. But the French revolution, by affording new and more powerfully stimulating fuel to their dissentions, ultimately defeated all attempts at reconciliation. The Anti-federalists appear to have greeted that event as a harbinger of the universal establishment of their sentiments, and endeavoured, by every measure which enthusiasm could suggest, to accelerate its triumph over antient politics. Their first effort was naturally enough directed against the remains of monarchical prejudices and practices in their own country; and accordingly, even the harmless and perhaps really necessary forms of the President's routine, were at last denounced as scandalous encroachments on liberty, calculated to wean men from it, and to introduce despotism, with all its trumpery, in its place. These sentiments were of course productive of suggestions for an alliance with France, now represented as the great restorer of the lost rights of mankind, and as destined to effect the emancipation of the world. The Federalists, on the other hand, without forgetting in any degree the former services of that nation, and having rather indeed the sympathy of gratitude towards it, were far from thinking that any circumstances warranted a departure from the strictest neutrality with the states of Europe, and, least of all, that any new conflict, or even a serious difference with Britain, could promote the welfare of America. Washington himself, who was re-elected to the presidentship in 1793, declared decidedly in favour of England, with which country a friendly treaty was formed in the following year, chiefly through his means. This certainly gave umbrage to the French Directory; but, by prudent management, hostilities were prevented. Mr Adams, who succeeded to the presidentship on the resignation of Washington, held similar sentiments and pursued a similar conduct.

War with Britain.—The elevation of Mr Jefferson to the head of the executive department in 1800, was followed, as might have been anticipated, by very different counsels, and a totally dissimilar policy, which continued with little if any abatement of hatred towards England, but with sundry modifications of malicious device, during the whole tremendous course of the revolutionary wars. We are far from thinking that there did not occasionally arise, on her part, some causes of offence, which might not in any common case have excited animosity if not hostilities between the nations. But these seem to have been almost inseparable from her critical condition, as the only remaining bulwark in Europe against a most intolerable tyranny, and would have been forgiven by any state that was not actuated by rancorous recollections, which prevented it from appreciating the value and probable consequences of the struggle. The forbearance of the Americans, under many provocations arising from the varied and arbitrary politics of France, must ever be placed in dishonourable contrast with that irritability and impatience which urged them to seek revenge in the multiplied calamities of an ancient friend. They had the merit, however, of selecting a period for their operations most likely to give satisfaction—when the whole resources of their antagonist were barely sufficient to afford a ray of hope to the overwhelmed empires of Europe. The war of 1812 found Britain engaged in a conflict on which the welfare of the human race depended; no wonder that she was somewhat slower in answering the challenge than became her former glory and her present unconquerable mind. By the events of the succeeding contest, she certainly did not enhance her naval or military reputation.

The Americans, on the contrary, were very fortunate by sea, especially at the outset, in which, however, they usually had the advantage of superior metal and fresher seamen; and though often defeated on land, had nevertheless the honour of at last successfully combating some of the choicest troops of their enemy. This war was prolonged, to the manifest injury of both countries, after the ostensible reasons which had occasioned it ceased to operate. But the restoration of peace to Europe, consequent on the first effectual coalition against Bonaparte, and his subjugation, accelerated its termination, which

United States.

West India Islands.

was brought about by the appointment of commissioners from each power assembled at Ghent in 1814. We hope, rather than believe, that peace was made in the "spirit of peace," and that a return of the advantages of commercial and friendly intercourse, will obliterate every ungenerous feeling between two nations, which must ever have greater cause for alliance than temptations to commit themselves to mutually destructive contentions.

Statistics.—The revenue of the United States, which, before the last war, was chiefly derived from the duties on imports and tonnage, had increased rapidly between the periods of 1791 and 1801, amounting, in the former year, to 3,329,750 dollars, and in the latter to 18,000,000. Of its amount between the last mentioned period and the commencement of the war in 1812, we have seen no satisfactory statement. In the course of the war it was found necessary to levy new taxes for defraying the increased expenditure, and these, in addition to the immense diminution of their commerce, must have produced a very general dislike to a contest with Britain. On an average of three years preceding 1805, it appears, from efficient returns laid before Congress, that the United States had imported annually from that kingdom and her dependencies to the value of more than eight millions sterling, while their exports to Britain and her colonies rarely exceeded five millions in each year; in the three years again ending after 1804, the average of exports to the United States was above twelve millions, and that of imports from them not more than four and a half millions. Some inference may be made from these premises of the advantages which Britain derived from her commercial transactions with that people.

A standing army being judged inconsistent with a republican government, the military strength of the United States is to be estimated from the militia, which was formerly reckoned by Dr Morse at 700,000, but on grounds not entitled to entire confidence. We should think the effective force not greater than the half of that number; but all calculations of the resources of the Americans are liable to perhaps greater errors than are usually experienced in the case of other nations. Their navy, in 1804, consisted of no more than twelve frigates from 36 to 44 guns, and some smaller craft; at the commencement, and during the continuance of the war, it was augmented with astonishing rapidity, both in number and magnitude, and is probably destined, in course of time, to assume a first-rate importance among the Atlantic fleets.

IV. West-India Islands.

The islands to which our attention is now to be directed, as connected with this quarter of the world, may be said, in general terms, to run in a south-east direction from the coast of Florida to the north-east part of South America, forming a sort of interrupted barrier to the gulf of Mexico and the Caribbean sea. In other words, they describe nearly the diagonal of a parallelogram, of which the sides are the 59° and 86° of W. Long. and the 10° and 20° of N. Lat. This diagonal, it is to be remarked, is of very variable breadth; and there are several smaller islands in different parts of the neighbouring coasts, which cannot be referred to it. In geography, we may notice, it is often convenient, for the assistance of the imagination and memory, to start a strong idea of the relations of places, though a very accurate examination might not require its precise adoption.

West India Islands.

These islands have received very different names, which have been applied to them either considered in one assemblage, or as subdivided into particular groupes, according to their geographical position, or some other principle of arrangement.

The common term, West Indies, not indeed strictly proper, is abundantly extensive in signification to comprehend all the islands of which we shall speak, without any regard to the discordant sentiments of different writers in the application of the minor designations, Antilles Great and Less, Windward and Leeward Islands. We commence from the north, merely glancing, in the first place, at a small cluster, not indeed immediately connected with the West Indies, but which may be more properly mentioned here than in any other part of our arrangement.

The islands now alluded to, named after the discoverer Bermudas, and sometimes Somers, (vulgarly Summer,) from the circumstance of the shipwreck of Sir George Somers in 1552, lie about 600 miles to the east of the coast of Carolina. They amount to some hundreds, but most of them are small and uninhabitable, and a reef of rocks and shoals by which they are surrounded renders access to them rather dangerous. In general, the climate is mild and healthy, but thunder and hurricanes are frequent, and the heat of summer is sometimes excessive. A soil, fertile enough in a few spots, produces Indian corn, roots, and fruits, in quantities sufficient for the inhabitants, and is occasionally adorned with trees, which are clothed with almost constant verdure. But the greatest part of the lands susceptible of cultivation still remains in a state of nature. The inhabitants, who are chiefly English, scarcely exceed 5000. St George-town, in the island of the same name, one of the largest in the cluster, is the capital. It contains about 500 houses, and is partially fortified. These islands belong to Great Britain, but can hardly be said to be of any value to that government. The chief employments of the people in these islands, besides the necessary care of the ground, are building vessels, for which they are well supplied with wood of the cedar species, and weaving sail-cloths.

The Bahama, or Lucayos Islands, lying at a short distance off the coast of East Florida, are very numerous, and occupy a large space. But many of them are mere rocks, and the greater part are totally unworthy of notice. The most important are *Eleuthera, Lucayo, Bahama, Yuma, Guanahani* or *St Salvador, and Providence.* In point of soil, they are said to be fertile, and in many respects to resemble South Carolina. Fruits are abundant, cotton and coffee are raised for exportation, and they are admirably situated for the purpose of trade. The population in 1803 was nearly 15,000, and is understood to be on the increase. Encouragement from

West India Islands.

the British government, to which they belong, may bring these islands to a state of great prosperity.

Cuba,—a valuable island, of great extent, being about 700 British miles long, and 70 broad, lies to the south-west of the Bahamas, from which it is separated by the bank and channel of Bahama. It is divided in the middle by a ridge of mountains running the whole extent of the island, and giving rise to several rivers or streams. These mountains are commonly covered with trees, among which are found ebony and mahogany; but towards the coast, the flat lands are in possession of a soil so fertile, that, with scarcely any cultivation, it perpetually abounds in almost every kind of vegetable riches. The chief productions are ginger, sugar, coffee, cocoa, tobacco, and cotton. In point of climate, this island is very fortunate, having scarcely any winter, and the heat of summer being much moderated by breezes from the sea. Certain districts, however, are reckoned unhealthy; but in great degree this is occasioned by the imperfect state of cultivation. The chief inconveniencies met with in Cuba are hurricanes and storms of thunder. In 1804 the population was said to exceed 400,000 souls, of whom a very considerable part was made up of slaves.

Few countries are so well furnished with bays and ports, or are so well situate for trade. But these and other advantages are far from having excited the enterprise and solicitous industry of the Spaniards, who seem to have hardly any other conception of wealth than as it exists in the state of gold and silver. Havannah, the principal town of Cuba, is built on the north coast, where there is a harbour of great extent and much security, but rather narrow of entrance. The town, which has somewhat of an European appearance, is fortified, and contains about 25,000 people. Puerto del Principe, Bayamo, St Jago, San Carlos, Holguin, and Guiza, are the names of other towns, none of which is near so large or important as Havannah.

Jamaica,—a fine island, lying about 100 miles to the south of Cuba, is the third in size in the whole of the West Indies, and is inferior only to Cuba and St Domingo. Its extreme length seems to be about 160 miles, and its breadth 60; but, according to some accounts, its length is only 120 miles, and its breadth 42, while others state the dimensions higher than above, and Mr Edwards makes the former 150, and the latter 40.

Traversed by mountains in different directions, but particularly from east to west, plentifully watered by an immensity of small rivers and streams issuing from the high lands, beautifully adorned with many species of trees, and enjoying a climate more temperate and agreeable than its geographical position would indicate, this island undoubtedly merits distinction as one of the best examples of a West Indian country. Its general appearance differs from most parts of Europe; and the north and south sides of the island differ also as widely from each other. An idea of this may possibly be conveyed by a few particulars selected from the description given by Mr Bryan Edwards, to whose History of the West Indies we must refer the reader for minuter information.

On the north shore, the country rises into hills more remarkable for beauty than for boldness, having a gentle acclivity, and being interspersed with vales and romantic scenery, but rarely broken abruptly or disfigured with craggy projections. The tops of the hills also are nicely rounded, and covered with groves of pimento, spontaneously sprung up, whose fine deep tints are charmingly enlivened by the verdure of the turf, seen in a thousand openings beneath. The effect is still farther heightened, and some agreeable emotions are excited, by the profusion of streams which pour from every valley, and which frequently project themselves from the overhanging rocks, as if in sportive joy, into the ocean. At a greater distance inland, and overtopping these picturesque appearances, the land rises towards the centre of the island, displaying a still greater profusion of wood, till the hills, at the extremity of the scene, becoming fainter and fainter, lose themselves in the clouds.

The character of the southern side, on the contrary, is that of grandeur and sublimity.—"When I first approached this side of the island by sea," says Mr Edwards, in his poetic language, "and beheld from afar such of the stupendous and soaring ridges of the Blue Mountains as the clouds here and there disclosed, the imagination (forming an indistinct, but awful idea of what was concealed, by what was thus partially displayed) was filled with admiration and wonder. Yet the sensation which I felt was allied rather to terror than delight. Though the prospect before me was in the highest degree magnificent, it seemed a scene of magnificent desolation. The abrupt precipice and inaccessible cliff had more the aspect of a chaos than a creation, or rather seemed to exhibit the effects of some dreadful convulsion which had laid nature in ruins. Appearances, however, improved as we approached; for amidst ten thousand bold features, too hard to be softened by culture, many a spot was soon discovered where the hand of industry had awakened life and fertility. With these pleasing intermixtures, the flowing line of the lower range of mountains, which now began to be visible, crowned with woods of majestic growth, combined to soften and relieve the rude solemnity of the loftier eminences; until at length the savannas at the bottom met the sight. These are vast plains, clothed chiefly with extensive cane-fields, displaying, in all the pride of cultivation, the verdure of spring blended with the exuberance of autumn, and they are bounded only by the ocean, on whose bosom a new and ever-moving picture strikes the eye; for innumerable vessels are discovered in various directions—some crowding into, and others bearing away from the bays and harbours, with which the coast is everywhere indented." We should err, however, if, from such descriptions, or any conclusions drawn from the position of this island, we conceived it to be peculiarly delightful as a place of residence. The violent torrents of rain at certain seasons; the frequency of storms, tempests, and hurricanes, and the prevalence of thunder and lightning for half the year, greatly diminish the comforts and security of the inhabitants. The nature of the vegetable productions raised in Jamaica will be readily understood from what has already

West India Islands.

been said of some other countries with which it agrees in situation. The chief difference is occasioned by the almost accidental peculiarities of the trade in which it is concerned. Thus Jamaica, at one period, yielded three-fourths of the coffee and one-half of the sugar produced by the whole of the British colonies; but these proportions have of course varied greatly, according to the demands of the market. The amount of the population, in 1787, was computed at 291,400, of which no less than 250,000 were slaves.

Kingston, the capital of Jamaica, is a thriving town, with 30,000 inhabitants, situate on the south side of the island, and on the north side of a harbour capable of holding 1000 ships. Some of the houses are well built, and its markets for butcher's meat, fish, fruits, and vegetables, are noted for their excellence. Its extensive commercial transactions render Kingston a place of very high consequence in the British transatlantic dominions. Spanish Town, or St Jago de la Vega, the seat of government, is a very agreeable town in the interior of the island, and 16 miles from Kingston, which it does not equal in size or importance of trade. Port-royal, opposite to Kingston, in the same bay, was once a flourishing place; but being visited in 1692 by an earthquake, which buried nine-tenths of the houses several feet under water; secondly, at the distance of ten years, almost entirely reduced to ashes by fire; and, lastly, on its third appearance, demolished by a hurricane, the people took alarm, and almost universally abandoned the spot as forbidden ground. The last calamity occurred in 1722, since which period, however, about 200 houses have been built on the same foundation, and probably, as its advantages in respect of harbour, &c. are great, it may recover some of its former consequence. Most of the other towns in this island are small.

St Domingo, Hispaniola, or Hayti—lies to the eastward of the two islands last described. It is reckoned from 350 to 400 miles long, in the direction of east and west, and from 100 to 140 broad from north to south, and is next to Cuba, in respect of size, among the West India islands. From Cuba it is separated by a channel, denominated by seamen the windward passage, which is about 36 miles wide. To both of these islands it bears considerable resemblance in general appearance, the nature of the climate, and the productions of the soil. Perhaps, on the whole, it surpasses them in the salubrity of the air, and in profusion of vegetation. The former, in a great degree, is to be imputed to the existence of fewer flat moist lands, and a more frequent alternation of hills and valleys; the latter is the natural consequence of superior richness, or greater depth of soil. Some places, however, are peculiarly unhealthy, owing to a great number of salt marshes.

Of the population, condition, resources, and productions of St Domingo, we can scarcely be said to have any very satisfactory accounts since the revolt of the negroes, and the consequent declaration and acquisition of their independence.

Porto Rico, an island belonging to the Spaniards, lies due east at a short distance from St Domingo, and is very nearly as large as Jamaica. In beauty of appearance, fertility of soil, abundance of streams, and temperateness of climate, it yields, perhaps, to none of the West India possessions; but, as usual, the policy of the European masters prevents any satisfactory disclosure of its true condition and produce. Among the articles enumerated in the statements of its value, it is usual to mention the mines of silver and gold on the north side of the hills by which it is divided in the direction of its length.

In 1778, the inhabitants were estimated at upwards of 80,000; but this, probably, was an exaggeration. Of its present population we have no conjecture. The capital, which bears the same name, is on the north part of the island, and is said to be a well-built town, having a good harbour.

Santa Cruz produces sugar, coffee, and cotton, has some good ports, and is well inhabited. *St Thomas*, not near so large, is proportionally as rich, and has an excellent harbour. *Tortola* is noted for a capacious road, where 1000 vessels may safely anchor.

The Caribbee, or Caribbean Islands, which are very considerable in number, and of material importance in a commercial point of view, extend in a sort of circular direction from the Virgin Islands towards the American coast, comprehending Barbadoes, which is more to the east than any of them, and Tobago, which is more to the south. *Anguilla*, or *Snake-Island*, so called from its shape, is a small flat island, tolerably fertile, and containing a few hundred inhabitants. *St Martin's*, a little to the south, is rocky, and not very productive, having but a thin soil, and no rivers. In some respects it resembles *St Bartholomi*, or *Bartholomew*, which, however, yields more sugar and tobacco. *Barbouda*, to the eastward of these two islands, is lofty in the middle, flat and low on the margins, affords good pasture for cattle, but is otherwise very sparingly productive, and being difficult of access from the encircling rocks and shoals, has been almost entirely neglected.

St Christopher's, or *St Kitt's*, is larger and more valuable than any of the islands just now named, is about 40 miles in circuit, produces sugar, tobacco, cotton, and fruits in great abundance, and has a population amounting to about 30,000 souls, of whom the majority are negroes. A good deal of this island is supposed unfit for cultivation, but the whole has a fine romantic appearance, and it possesses a healthy climate. Springs are abundant in the island, but commodious harbours and landing-places are wanting. North-west of St Christopher's are two small islands, *Saba* and *Eustatia*, both but indifferently productive, and also very defective as to ports. *Nevis*, separated by a narrow channel from St Christopher's on the south, presents the appearance of a single mountain, surrounded by a margin of low lands. The soil is not very rich, nor is there any harbour on the coast, but the island is well supplied with fresh water, and is inhabited by above 10,000 persons, by much the greater part of whom are negroes. Eustatia, St Christopher's, and Nevis, exhibit volcanic appearances.

Antigua, 60 miles south-east of St Christopher's, is about 50 miles in circuit, and contains nearly 60,000 acres of ground, the whole of which, with some trifling exception, is either employed in the growth of the sugar-cane, and other useful vegetables, or is of value for pasturage. In respect of good harbours, it is superior to most of the West-India islands. Its chief imperfection is the scarcity of fresh water; most of what is used is collected from the clouds, as the product of the streams and wells is in general brackish and disagreeable. The heat is often excessive, and destructive hurricanes are not unusual. In consequence of these causes, the crops of Antigua are uncertain, and often fail. Of the population of this island we have no very recent account: in 1774, the number of whites was 2590, and there were 37,808 slaves; the latter were estimated, in 1787, at 60,000.

Montserrat, a small oval-shaped island, about 20 miles to the south-west of Antigua, and about the same distance south of Nevis, is fruitful and pleasant, agreeably diversified with hills and vales, the former covered with a variety of trees, and the latter having the advantage of sufficient streams and a generous soil.

Guadaloupe, to the south of Antigua, consists, in fact, of two islands connected by a small arm of the sea, which is navigable for vessels of 50 tons. That portion to the east is called Grande-Terre, the other to the west Basseterre, the two together being above 200 miles in circumference. Grand-Terre is destitute of water, and possesses but an indifferent sandy soil; it is, therefore, but thinly inhabited, and poorly cultivated. The other division, which, from the circumstance of its first discovery, is often denominated peculiarly Guadaloupe, has abundance of water, a superior soil, and, from its number of hills and woods, displays some romantic scenery. Sugar, cocoa, coffee, and cotton, are the chief products of this island, which on the whole may be reckoned one of the most important of the West-India settlements. No wonder, then, that its cession by the British, who captured it from the French in 1810, to another power, conceived little entitled to such a boon, has been represented as an uncommon stretch of political generosity. Several small islands in its vicinity are considered as dependencies of Guadaloupe. Of these, *Maria-Galanta* and the *Isles des Saintes*, are of most consequence. Both have patches of good soil, are tolerably cultivated, and carry on some trade.

Dominica, about 20 miles south of Guadaloupe, is 29 miles in length, and 16 in breadth, presents a hilly appearance, and has but a small portion, comparatively speaking, of fertile land. It is, however, well watered, possesses a healthy climate, and has one of the largest and safest bays in the West-Indies. Its population is, perhaps, little short of 30,000 souls, two-thirds at least of which are slaves. The possession of this island, from its peculiar situation with respect to some of the French islands, was long an object of solicitude to the British government.

Martinico, one of the islands now alluded to, lies a little to the south-east of Dominica. It is about 135 miles in circuit, has an uneven irregular surface, the higher parts of which are covered with forests; is plentifully supplied with water, not always indeed of the best quality, and sometimes descending from the hills in rapid and destructive torrents; possesses considerable varieties of soil, from the most barren to the most liberal; and in point of climate, (were some of the masses of wood, which prevent the escape of moisture from the lands, removed,) could not be said to be unhealthy. The coast has many indentations, presenting safe and commodious anchorage. The conveniences of Martinico so much exceed its disadvantages, that the possession of it must necessarily be considered of very high consequence.

St Lucia, about 20 miles south of Martinico, is but a small island, unequally fertile, imperfectly cultivated, but capable of considerable improvement; has a diversified appearance, and possesses an excellent harbour. The population is probably little under 20,000.

St Vincent, still farther to the south, contains about 84,000 acres of land, well watered, but with a very unequal surface. The hills are mostly covered with woods, the valleys are in general of great fertility, but hitherto either nothing like the full extent of the requisite labour has been bestowed on the cultivation of the country, or a large portion of it is incapable of improvement. The British possess the most valuable parts, the others are still in the hands of the native Caribs.

Barbadoes, the most easterly of the West India islands, is 21 miles long and 14 broad, containing upwards of 100,000 acres of land, mostly cultivated. The soil being variable in nature as well as quality, admits diversity of product in considerable abundance; and the air is, on the whole, mild and healthy, not very subject to sudden changes of temperature, and little or not at all vitiated by moisture arising from marshy grounds. Though there be no river in the island, yet it is tolerably well supplied with water from many small springs, and, besides the rain in the wet season, by dews which are frequent during the night. In point of appearance Barbadoes is agreeable, having gentle risings, hills of easy ascent, and extensive plains, abounding in vegetation, which alternate or contrast with each other. Much of the coast is dangerous of access, from rocks and sand-banks, but there are some good harbours on the west side. Hurricanes, unfortunately, often interrupt the happiness of its inhabitants, and mar the products of their industry, besides exposing them to still more fatal effects. Thus the storm of October 1780 is said to have destroyed no less than 4000 persons. The number of inhabitants in 1786 was 16,167 whites, 838 free negroes, and 62,115 slaves.

To the south-west of Barbadoes are situate *Grenada* and the *Grenadines*. The former has a hilly irregular appearance, is well watered, has on the whole a good climate, and contains about 80,000 acres of land, the greater part of which is capable of cultivation. It has some good harbours, and is not much visited by hurricanes, at least such as are very ruinous. The population exceeds 20,000. Of the Grenadines, which form a chain in the direction of St Vincent towards the north, *Caricuacou* or *Cariacou*, *Redonda*, and *Bequica*, are the chief. They are small, and badly watered, but of tolerable fertility.

Tobago, the most southerly of the Caribbean islands, is about 30 miles long and nine broad, has a more temperate climate than is indicated by its situation, and is out of the tract of the hurricanes which so often threaten the total destruction of the other islands. The country has a very agreeable appearance; the soil is rich, springs of water are abundant, and the coast affords good shelter for vessels. Altogether, this island is highly favoured, and is a most eligible place of residence.

To Edward's History of the West Indies, Dr Pinkard's Notes on the West Indies, and Mackinnon's West Indies, we refer the reader for minute information respecting all or any of the islands now mentioned. Pinkerton's Geography, 3d edit. contains some useful extracts from these and other publications.

Trinidad, which is separated from the continent by the gulf of Paria, is reckoned about 90 miles long, and from 30 to 40 broad, and has on the whole a healthy climate and fertile soil, affording almost all the vegetable productions found on the American continent in its vicinity. There are several hills in the country, occupying about one-third of the whole surface, and much remains waste that is capable of being beneficially cultivated. Indian corn, great varieties of fruits and roots, tobacco and cotton, are among its most plentiful products. Earthquakes are sometimes experienced in this island, but hurricanes are unknown. The population of Trinidad was estimated some years ago at 17,749 souls, of which 10,000 are slaves. A lake of mineral pitch, subject occasionally to a kind of ebullition, and supposed to be of volcanic origin, is a peculiarly interesting phenomenon in this island.

Margaretta, lying off the coast of Cumana, is about 40 miles long and 18 broad, has no other water than what descends from the clouds, possesses rather a barren soil, and is inhabited chiefly by fishermen.

Blanca, *Tortuga*, *Orchilla*, *Bocca*, *Buen-aire*, and several other small islands which lie off the same coast and the Caraccas, do not admit of particular notice. *Curacoa* is about 36 miles long and 10 or 12 broad, covered with a thin layer of earth, capable, however, of culture, having some good harbours and a neat town of the same name, and carries on a tolerable trade, not by any means so extensive as formerly.

V. Discovery, Conquest, and Settlement of America.

The ancients were totally ignorant of this quarter of the world. A few obscure and dubious expressions found in their works, on which some enthusiastic admirers have descanted with undue confidence, partake more of the colouring of fancy than the solidity of actual observation. It is unlikely, we may say impossible, that without the aid of the magnetic needle so long a voyage should be performed; and the supposition is quite unsupported by any sort of testimony, that there formerly existed some intermediate country, such as islands, afterwards annihilated by a convulsion of the earth, which might serve as the means of communicating with the western continent. We must abandon conjectures, however plausible, when the object is to ascertain and do justice to the merits of a discovery so brilliant in itself, and so rich in consequences. It is equally incumbent on the historian to steel himself against extravagant pretensions, which have no other foundation than legendary reports and national vanity.

Dr Robertson has specified, with his usual perspicuity, the reasonings and opinions which led the illustrious Christopher Colon, or Columbus, to expect the discovery of new regions in the western ocean, or, at least, that, by holding on his course towards the west, he should arrive at some countries connected with the previously known continent of India. We have only to mention the consequences of this novel and arduous undertaking.

First voyage of Columbus.—Repeatedly and most vexatiously disappointed in his applications to some of the crowned heads of Europe, this man at last obtained the tardy and, indeed, puny encouragement of Isabella, one of the monarchs of Spain, to his projected operations. With the enthusiasm of a martyr, if not the caution of a philosopher, he set sail from Palos, in Andalusia, on August 3. 1492, with three small and indifferently constructed vessels, on a voyage unprecedented and universally condemned, which was to risk his fortune and his fame, and which, in the opinion of nearly the whole of the calculators of his time, even those, too, who gave their sanction to the enterprize, was much more likely to ruin both, than to obtain for him the honour of the most stupendous experiment yet performed in the science of geography. The incidents which occurred in this first voyage have been recorded with scrupulous, we may add, not unmerited devotion. On October 12. when the patience and confidence of his suffering companions were completely exhausted, and their indignation was wound up to a degree that threatened his life, Columbus had the delightful satisfaction of seeing a spot of land amid the immensity of the ocean which had so long appeared to baffle and to augment on his labours. It was the island of Guanahani, as the natives called it, one of the Bahamas, to which, however, Columbus gave the name of San Salvador, situated not less than 3000 miles to the west of Gomera, one of the Canary islands, where he had last touched in his perilous navigation.

The productions and appearance of this island by no means corresponded with the sanguine expectations of the Spaniards; but the possession of some small plates of gold, used as ornaments by the natives, gave rise to anxious inquiries for the place whence that precious metal had been obtained. The information procured on this point, and indeed his own peculiar views respecting his present situation, induced Columbus to direct his course towards the south. Besides some smaller islands which he fell in with in the course of this voyage, Cuba, named by him Juanna, and Hayti, which he called Espagnola, and on which he built a fort, were discovered. The state of his vessels, and the natural anxiety of his men, added to his own reasonable wishes to publish his discoveries to the world, now prompted him to return home. After encountering severe storms, which threatened the extinction of all his hopes, and having taken shelter, first in the Azores, or Western Isles, belonging to the crown of Portugal, and subsequently at Lisbon, he arrived at Palos on the 15th

Discovery of America.

March, after an absence of seven months and eleven days from the time of setting out on his voyage.

Second voyage.—The success of this expedition, it may very well be believed, brought so great a degree of credit to Columbus, that his suggestions for a second voyage were readily followed by preparations of a more extensive and encouraging nature. Not fewer than 17 vessels were immediately furnished with every requisite which his experience or opinion pointed out; and 1500 persons, some of whom belonged to the noblest families in Spain, were proud to embark with him. In this second voyage, commenced on September 25. 1493, some of the Caribbean islands were discovered. He did not return till 1496, much of his time being occupied in building a town in Hayti, arranging a government for that island, and in measures calculated to extend his discoveries, and direct them to beneficial purposes. In a third voyage, undertaken in 1498, Columbus, by sailing farther towards the south than he had formerly done, fell in with the island of Trinidad, and got sight of the mouth of the Oronoco. He afterwards surveyed the coasts of Paria and Cumana, the first parts of the continent that were discovered.

Last voyage of Columbus.—His last voyage, in 1502, carried him to another part of the continent, viz. the coast between cape Gracias a Dios and Portobello, which he surveyed. The fame of the discoveries made by this enterprising character roused a spirit of emulation throughout Europe. Voyages in search of unknown regions became an object of almost ordinary ambition, which was kept up by habit and the agency of many causes, long after there ceased to be any very high reward for the perils and privations which they occasioned.

Origin of the name of America.—One of the earliest of these expeditions deserves to be mentioned, not so much from the amount of the discoveries made, as from a circumstance which ultimately proved injurious to the just claims of Columbus. What we allude to is a voyage in 1499 under Ojeda, one of the officers who accompanied that navigator in his second enterprise. A person of the name of Amerigo Vespucci, a native of Florence, who seems to have acted the part of chief pilot in this expedition, on his return home published an account of the regions which he had visited. This being the first literary production respecting the New World, naturally enough had the effect of connecting his name with the subject of his writing; and accordingly, in a short time, the whole of the lands recently discovered, to which no peculiar designation had been appropriated, was currently denominated America. No fraud, or gratification of vanity, appears to have been intended by this man in giving rise to the title, which, however, in spite of repeated interference on the part of those who were anxious for the well-merited reputation of Columbus, has never been cancelled from the geographical vocabulary.

Of some of the chief voyages of discovery we shall now speak in order of time, but without occupying much room in the enumeration of circumstances.

Newfoundland and Labrador discovered.—John Cabot, a Venetian, but employed in the service of Henry VII. of England, who probably now regretted his not having listened to the application that had formerly, in an indirect manner, been made to him by Columbus, sailed from Bristol in 1497. By holding on a due west course, he fell in with the island which has ever since gone by the name affixed to it by his sailors, viz. Newfoundland. He afterwards coasted down the shore of North America as far as Virginia, when he returned home, successful in the main, as to important discovery, but disappointed as to the chief object for which he undertook the voyage, viz. to obtain a new and nearer passage to India. Corte Real, a Portuguese, anxious for a similar discovery, which formed indeed a prime concern in most of the expeditions of this period, got sight of the coast of Labrador in 1500.

Brazil discovered.—About the same period, another native of Portugal made a much more important discovery, and that, too, without any particular effort, unless to avoid the variable winds, which had so often been encountered on the coast of Africa by vessels going to India round the cape of Good Hope. Having for this purpose stood farther out to sea than was usual, he got sight of the coast of Brazil, on which he landed, and which has since proved so valuable an acquisition to his countrymen. The continent of America, therefore, it may be said, would have been discovered even without the sagacity of Columbus, though it is not unlikely that the Portuguese commander was encouraged to depart somewhat from the usual track of navigation by what he had understood of his previous success.

Further discoveries.—In 1501, Bastidas, a Spaniard, sailed along the coast of Terra Firma from cape Vela to the gulf of Darien. A similar voyage was performed soon after by Ojeda and Amerigo Vespucci, before spoken of. Juan Diaz de Solis and Pinzon discovered the province of Yucatan in 1508. A few years afterwards the former navigator sailed along the coast of South America as far as the Rio de la Plata. Previous to this, two considerable discoveries were made, that of Florida by Ponce de Leon, and the western coast of America, to the east of Panama, by Bilboa, who, with a small body of men, crossed the isthmus of Darien. He was the first European who reached the shores of the Pacific ocean. Bilboa is said to have waded into it, taking possession in the name of the Spanish monarch.

Mexico conquered.—In 1518, a small fleet, under Grijalva, sailing westwards along the north coast of Yucatan, discovered those lands in the gulf of Mexico which have since borne the name he assigned to them, New Spain. This led immediately to an armed expedition under Fernando Cortez, for the purpose of effecting the conquest of the country. The complete subjugation of the natives, and the establishment of the Spanish power, after a series of cruelty and injustice altogether unparalleled, were accomplished in 1521.

The Globe first sailed round.—About the same period, Magalhaens, a Portuguese, in the service of Spain, searching for a western passage to India, discovered the straits at the extremity of the southern continent which still bear his name, and which

Discovery of America.

eventually led to an extensive knowledge of the western coast. This voyage is peculiarly remarkable as the first circumnavigation of the globe, and of course the decisive proof of its general form.

Peru conquered.—Pizarro, in a vessel that sailed from Panama, on the west coast, visited the kingdom of Peru, of whose riches some fascinating reports had been previously received. His proceedings for its conquest began in 1530, and were not completed till after a period of 10 years.

French expedition.—In 1534, Francis I. fitted out a fleet at St Maloes for the purpose of making discoveries in North America. The command was given to James Cartier, who having first reached the coast of Newfoundland, sailed northwards till he reached the gulf and river called by him Saint Lawrence, after the saint whose name was attached to the day on which he made the discovery. In the following year he navigated that noble river for about 900 miles, giving the country the title of New France, in which he built a fort, and resided for the winter. Some efforts were made by the French a few years afterwards to colonize this country. A nobleman of the name of La Roche, obtained a grant of it from the king; but it was not till the commencement of the next century that their renewed efforts were crowned with success. See *The Natural and Civil History of the French Dominions in North and South America*, by Jefferys. Lond. 1760.

Mississippi discovered.—Ferdinand de Loto, a Spanish captain, having sailed from Cuba with a body of men intended for the conquest of Florida, landed in the bay of Spirito Santo, whence he marched in a north-west direction to about 35° on the banks of a river, where he died. His successor built some small vessels, in which he passed down the river till he entered the gulf of Mexico. Those transactions took place between 1539 and 1543. From several circumstances, it is very manifest that the river thus navigated was the Mississippi, now for the first time discovered.

Settlement in Florida.—Chatillon, admiral of France, early in the year 1562, equipped a fleet under the command of John Ribalt, destined for the American continent. It arrived on the coast of Florida on the 1st of May, from which circumstance he designated a river then discovered, May river, supposed to be the same that is now called St Mary's, and which forms part of the boundary of the United States. Coasting northwards, Ribalt discovered eight other rivers, to one of which he gave the name of Portroyal, and on another he built a fort, in which he left a colony, under the direction of captain Albert. This man's severity, however, occasioned his own death, and the ruin of the people committed to his care. In the month of June, two years after this event, Rene Laudonier, sent out also by Chatillon, anchored with three ships in May river, where he built a fort, to which, in honour of his sovereign, Charles IX., he gave the name of Carolina. In August of the same year Ribalt arrived at Florida a second time, having a fleet of seven vessels, intended for the service of the colony formerly left by him under Albert. He was pursued up the river where he had settled, by a Spanish fleet under Pedro Melandes, who, having obtained some advantages, barbarously put him to death, with his whole party. The tidings of this disaster reaching Laudonier, induced him and his comparatively feeble colony to escape to France, where, in the course of about three years after, a fleet was fitted out for the purpose of retaliating on the Spaniards who had so cruelly and unjustly possessed themselves of the country. This object was entrusted to Dominique de Gourges, and was most effectually accomplished, by the destruction of the fortresses which the Spaniards had erected, and the slaughter of very nearly all the men that defended them. Gourges, immediately after this gratification of revenge, returned home; and for about 50 years the French made no farther attempts to colonize Florida.

Expeditions of the English.—In 1576 captain Martin Frobisher, employed by England in making discoveries of a north-west passage to India, improved the geography of the North American coast, by the addition of several bays and islands. A strait to the north of Hudson's strait still retains his name. About three years afterwards, Sir Humphry Gilbert, in a voyage to Newfoundland, made some discoveries in that region, as St John's harbour, and the country to the south. He was lost on his return home. The voyage round the world, performed about the same period by Sir Francis Drake, had the effect of exciting a spirit of enterprise among his countrymen.

Sir Walter Raleigh's expedition.—In 1584 two patents were granted by queen Elizabeth, one to Sir Walter Raleigh, the other to Adrian Gilbert, for lands in North America not possessed by any Christian prince. Sir Walter fitted out two ships under the command of Philip Amidas and Arthur Barlow, who having anchored in a harbour about 20 miles west of the river Roanoke, on the coast of North Carolina, formally took possession of the country on 13th July, denominating it, in honour of their maiden queen, Virginia, an appellation soon bestowed on the whole of the English possessions in North America, but afterwards restricted to a state somewhat different from that to which it had been originally applied. A colony of more than 100 persons, left in this country by a fleet under Sir Richard Grenville, sent out by Raleigh in the following year, must have perished, had they not fortunately been visited by Sir Francis Drake, who carried them to England, after having made several conquests in the West Indies and other places. Grenville again arriving on the coast of Virginia, about a fortnight after the departure of Drake, though he knew nothing of the fate of the former colony, except that not a man of them was to be found, had the imprudence to leave at the same place a body of 50 men, none of whom remained in 1587, when governor White, sent out with a charter from Raleigh, arrived at Roanoke. Notwithstanding the fate of two former colonies, White ventured a third one; having, therefore, left 115 people at the old settlement, he returned to England. On August 13th of this year, it may be noted, Manteo, a native Indian, submitted to baptism in Virginia; he was the first who received that ordinance in this part of America; and on the 18th of the same month, a Mrs Dare was delivered of the first English child born in the country—it was a girl, to whom the name of Virginia was given. Equally unsuccessful, however, was this colony. The whole was either cut off by the natives, or perished from hunger, before the arrival of governor White with recruits in 1590. Farther efforts were abandoned. Here, then, it may be remarked as a very singular circumstance, that for more than a century after the discovery of North America, none of the European nations, with the exception of the Spaniards, had succeeded in an attempt to colonize it; and that, even so late as the period of queen Elizabeth's death in 1603, there was not one European family in all the immense regions between Florida and the coast of Greenland.

Virginia settled.—The foundation of the British dominions in this continent was laid in the reign of James I. This monarch, in the spring of 1606, by patent divided Virginia into two colonies: the *southern* or *first colony*, as it was called, and which comprehended all lands between 34° and 41°, was granted to the London Company; and the *northern*, or *second colony*, known also by the name of North Virginia, including the lands between 38° and 45°, to the Plymouth Company. These were associations formed, it would appear, at the recommendation of Hakluyt, a clergyman, to whom his country was indebted for much of her future glory as a mother of colonies. In order to prevent disputes between the two companies, it was expressly enacted, that they should not plant within a hundred miles of each other; yet with the greatest inconsistency, as is noted by Dr Morse, "the lands lying between the 38th and 41st degrees, are covered by both patents." The companies prosecuted their respective interests with zeal, but for some time with partial or inconsiderable benefit.

Progress of the London Company.—In 1606, the Earl of Northumberland's brother, in the service of this company, established a colony in Virginia, where he discovered the river Powhatan, or James river, as it is now called. On this river, in the following year, after the arrival of a new supply, a settlement was begun at a place named James town, which was the first town built by the English in North America. Captain Newport, who brought over the last recruits, having left Mr Edward Wingfield, president, with 104 persons, returned to England. In the winter of this year, James-town was burnt. By successive supplies, in 1608, and the following year, and after the company's council had obtained a new commission, the colony was increased to 500 men. It would have been greater if one of the vessels going out to it, had not been run ashore on the Bermuda islands, a circumstance that gave rise, as Sir George Somers was the commander, to their being called Somer Islands. The people who got on shore there having remained till they had built a sloop capable of transporting them, embarked for the colony, which, on their arrival they found had dwindled down to sixty persons, and these so miserable and dejected, that the whole resolved with one voice to return to England. On their way down the river with this intention, they were met by a new supply under Lord Delaware, who had recently received a patent, appointing him governor and captain-general of South Virginia. At his persuasion, they returned to James-town; and from this event, which happened in 1610, we may date the effectual settlement of Virginia.

Of the Plymouth Company.—The first vessel employed by the Plymouth company was captured by the Spaniards. Two vessels were next sent out in 1607, and arrived at a place some miles to the south of Sagadahok river, where a settlement was commenced. But most of the people being distressed by the severity of the winter, only forty-five men, with their president captain Popham, could be induced to remain after the month of December. They were doomed to encounter immense hardships, partly from the nature of the climate, and partly from the destruction of their storehouse, and most of their provisions, by fire; and, although they received several supplies from home, the colony broke up and returned to England in the following year, having lost their president Popham; and in consequence of their unfavourable reports, several years elapsed before any more attempts were made to settle North Virginia. At last, about the year 1620, Mr Robinson, leader of a religious sect, which had previously fled to Holland to avoid a persecution commenced against them in their own country, accompanied by his congregation, arrived at Plymouth, where the first effectual settlement was established. This country had already attained the title of New England from Captain Smith, who had been sent out to examine a gold and copper mine, or, in case of failure, to fish and trade with the natives. To his skilful representations and map of this part of America, much of the subsequent endeavours to colonize it must be imputed.

Canada settled.—Champlain, a Frenchman, began a settlement at Quebec in 1608, which, after various fortunes and contests, remained in the hands of his countrymen till 1763, when they were dispossessed by the British, to whom the whole of Canada has ever since belonged.

Dutch settlement.—In 1608 or 1609, Henry Hudson, an English navigator, discovered Long-island, attached to New York, and the river which still bears his name. He afterwards sold his claim or right to the country to the Dutch, who in 1614 built a fort on the west side of the river, near Albany, to which they gave the name of Fort Orange. This colony several times changed masters, the original possessors and the English being often at war, and with variable success. It remained at last with the latter, till the accomplishment of independence at the American revolution. Newfoundland was settled in 1610 by about forty planters, under John Guy, appointed governor by patent from king James.

Settlement of New Jersey.—New Jersey is supposed to have been settled much about the same time as New York, and partly at least by Dutch emigrants from that colony. To these were added, in 1627, a body of Swedes and Finns, who settled on the Delaware, and from whom many of the present families are descended. The whole territory was afterwards seized on by the English, to whom, after a re-conquest by the Dutch, it was conceded at the peace of Westminster 1674. In July of that year, it was divided into West Jersey and East Jersey by the duke of York, to whom his brother had formerly assigned the property. But the boundary line was never so accurately ascertained as to prevent contentions among the subordinate proprietors. These contentions, and various others, produced such confusion, that the proprietors in 1702 surrendered the government to the Crown.

New Hampshire settled.—New Hampshire, though discovered in 1614 by captain John Smith, of whom we have already spoken, was not settled till 1623, by a small party of English, near the river Piscataqua. In 1640, there were four distinct governments established on the branches of that river. These not agreeing as to a plan for general government, solicited the protection of Massachusetts, at this time become somewhat considerable. But in 1679 New Hampshire was erected into a distinct government; and a controversy afterwards arose between the two provinces about their boundaries, which continued for a long time, and required the interference of the crown. This province took an active part in the proceedings which terminated in the establishment of the United States.

Massachusetts.—Captain John Endicott, and a small company, began a plantation at Naumkeag, or Salem, in 1627. This company, which was soon afterwards joined by about 200 persons from England, under four clergymen, was the original of Massachusett's settlement. It was rapidly augmented by successive and immense supplies of new comers, notwithstanding the hardships to which the early planters were exposed. The rage, indeed, for emigration to New England in general became so great, that the King issued an order, in 1633, to prevent it, but without full effect. This spirit ceased however in 1640, when a change of affairs took place at home, which probably occupied the ambition of those who had more to hope for than to fear in any revolution. It has been calculated, that the number of persons who had gone over to New England before that event amounted to 21,200; whereas the number of those who have since left that country materially exceeds that of the new settlers. Nova Scotia, which had previously been joined with Massachusetts, was taken from it in 1713, and erected into a distinct government.

Maryland.—In 1633 Charles I. granted a tract of land on Chesapeake bay to Lord Baltimore, a Roman Catholic nobleman, who, with a number of his brethren that were persecuted for their religion in England, settled on it, and gave it the name of Maryland, in honour of the queen. This province encountered opposition from the government of Cromwell, which could not be established in it without bloodshed. Although the original settlers were Roman Catholics, and the province was really considered as an asylum for persons of that faith, the Protestant religion was established in it by law in 1692.

Connecticut.—Connecticut was granted by the Plymouth Company to the Earl of Warwick, in 1630; but three years elapsed before any English families settled in it. Great additions were afterwards made by conquest from the natives, with whom the settlers had many and long wars. In several respects the history of this province resembles that of Massachusetts, with which indeed it was intimately connected. In both, we may remark, the religious society commonly denominated Quakers makes a singular figure, both as agents and sufferers. Most of the citizens of Connecticut, attached by habit to a republican form of government, and much accustomed to the exercise of their own judgments in matters affecting their interests, were zealous in promoting the cause of American liberty.

Rhode Island.—The settlement of Rhode Island originated in religious persecution about 1635. Mr Roger Williams, a clergyman, and about twenty persons who concurred in opinion with him, were actually banished from Massachusetts as disturbers of the peace of the church and commonwealth established there, by a people who had themselves experienced similar treatment for a similar offence, if a difference of judgment on disputable, and often indeed inexplicable points, merit such an appellation. They settled at a place called Mooshawsick by the natives, who shewed them more humanity than their brethren. Mr Williams called it *Providence*, with commendable piety. For some time this small body suffered much from fatigue and want. It was afterwards joined by new exiles from Massachusetts, where a spirit of bigotry and intolerance prevailed. More extensive possessions were now obtained, partly through the influence of Sir Henry Vane, junior, and partly by successive purchases from the natives. A very liberal government was soon erected, which offered complete freedom to all religious persuasions, and by which, in a short time, the prosperity of the colony was effectually promoted. It has been remarked by Dr Morse, as an evidence of the independence of religion on civil authority in this province, that " no contract between a minister and a society (unless incorporated for that purpose) is of any force."

Carolinas.—In 1662, Charles II. granted to the Earl of Clarendon and seven others almost the whole of the territories of the three southern states, viz. the two Carolinas and Georgia; and, about two years afterwards, the boundaries were enlarged by a second charter. The proprietors, in virtue of the authority thus vested in them, engaged Mr Locke to frame a system of laws for their intended colonies. No effectual establishment, however, was made till 1669, when governor Sayle, with a company, settled on a neck of land between Ashley and Cooper rivers. It was not long before the settlers quarrelled among themselves; and the proprietary government being at last found inadequate, the parliament of Great Britain took the province under their immediate care, all the proprietors, excepting Lord Grenville, agreeing to accept of a sum of money for their property and jurisdiction. This agreement being ratified in 1729, the territory was divided into North and South Carolinas, which remained separate royal governments till the revolution.

Georgia.—The settlement of Georgia was not effected till 1732, when General Oglethorpe, in prosecution of a benevolent and wise policy, to relieve

Discovery of America.

some poor people of Great Britain and Ireland, arrived with 115 persons in the country, and built a town, which was distinguished by the Indian name of Savannah, from that of the contiguous river. The province itself was called Georgia, in honour of George II. who favoured the motives and plan for its settlement. Of the humanity that prompted to this undertaking it is impossible to doubt; but, unfortunately, the injudicious measures and regulations by which the proposed good was to be accomplished were soon felt by the first settlers, who, accordingly, and perhaps, too, it may be added, from an idleness of disposition not unusual in the class to which they belonged, were readily induced to forsake the colony and to seek better things in Carolina. It was now resolved, as the country appeared likely, if in good hands, to prove of importance to Britain, to engage a hardier and more industrious set of men in their place. Germany and the Highlands of Scotland were now looked to for the proper supply of colonists. The publication of the terms at Inverness, in Scotland, brought forward an hundred and thirty Highlanders, who were immediately engaged, and soon transported to Georgia, where, on the very confines of the British and Spanish territories, certainly with little propriety of selection, they built a town, to which they gave the patriotic name of New Inverness. Nearly at the same time, a hundred and seventy Germans were settled in another part of the province. To these, and the remains of the former settlers, were added many of their respective countrymen, so that the proprietors had sanguine hopes of rapid prosperity. In this they were completely disappointed; and, at last, such was the distressed state of the colony altogether, that it became necessary to surrender their charter to the king in 1752. Notwithstanding the various modifications which succeeded this event, the colony long continued unprofitable, and in a languishing condition. The peace of 1763 was the era of its prosperity, when, under the paternal administration of Governor Wright, it acquired commercial consequence and political stability. The war between Britain and her colonies was peculiarly injurious to the interests of Georgia for the time; but it was not long in recovering its relative importance, when the succeeding peace yielded new dignity to the United States.

Pensylvania.—The province of Pensylvania, so named from William Penn, its founder, was granted by Charles II. to that extraordinary character, in consideration of the services of his father, Admiral Penn, to whom the crown was largely indebted. In addition to the royal charter which was signed in 1681, Penn had the prudence to procure a quit-claim deed from the Duke of York, of all lands which, from their particular position, could possibly be supposed mutual or doubtfully adjusted. Penn himself accompanied the first colony in 1682; and having entered into pacific and friendly terms with the natives, succeeded in its establishment. He continued with it as governor till 1684, when a dispute with Lord Baltimore required his return to England. Though his address in inducing the settlers to agree to his original scheme of government prevailed, and his influence over them, as it deserved to be, was great, yet he was frequently thwarted in his proposals; and contentions between the people and the deputies whom he appointed in his place were neither unusual nor easy of adjustment. But, on the whole, although some symptoms of arbitrary proceedings on his part or that of his agents appeared, and various modifications were introduced, this province enjoyed a mild government, and speedily flourished. To this end the complete freedom of religious opinion, and the lightness of the public burdens, powerfully contributed. The old constitution was abolished at the revolution, and the proprietaries who were absent were excluded from all share in the newly erected government, though they still continued to possess many tracts of lands, and were besides offered L.130,000 in lieu of quit-rents, which they consented to accept.

Vermont, &c.—Vermont, lying north of Massachusetts, was settled by emigrants from other provinces in 1764, and became an independent state in 1777. Kentucky, discovered by James Macbride in 1754, was not settled till 1773, by Colonel Boon and his family. Its progress has been rapid almost beyond belief, and can scarcely be paralleled in history. The territory lying north-west of the Ohio, generally called the Western Territory, was settled by the Ohio and other companies, and erected into a separate temporary government by an ordinance of congress, in 1787. The country called Tenassee was first explored about 1745; but though two or three times attempted to be colonized, was not permanently settled till 1774. An immense wilderness divided the people of this state from those of Kentucky. North Carolina, which had for some time exercised the government of this territory, ceded it in 1789, on certain conditions, to the United States, and accordingly Congress made arrangements for its administration. It became an independent state in 1796.

VI. Of the original Population of America.

Population of America.

We can scarcely close this sketch, without adverting to a topic which long excited attention, and which is yet far from having ceased to interest the minds of speculative men. America, when discovered by Europeans, was not an unpeopled country. Besides several tribes of intelligent beings, in a state of nature, indeed, but unequivocally possessed of the characteristics of mankind, there were found in it two nations, at least, which had vindicated their claims to this distinction, by an advancement in several of the social arts, and the establishment of civil and religious government. The nations alluded to are the Peruvians, inhabiting part of the west coast of South America, and the Mexicans, on the peninsula which joins the two continents; to which it is not improper to add, the Muiscos, or Moscos, who were established in a portion of South America, now comprehended in New Granada, and the Natches, resident near the mouth of the Mississippi. The question was as urgent as it was natural, "Whence came these people?" "From what source, setting aside the invincible demands of their intelligence and attainments, have they derived their right to the honours of humanity?"

Obscurity of the subject.—In replying to this question, conjecture has been substituted for decisive facts, and, of course, the answers are as numerous and whimsical as the imaginations and reasonings of the authors who have treated of it. There seemed an apology for their various and discordant opinions in the circumstance of the newly discovered people themselves being totally unable to afford a particle of information on the subject. What inferences, then, could be deduced from the accidental, and perhaps aggravated resemblances which were observed between them and the people of other continents, especially such as concerned manners and customs, which could hardly have been copied and preserved with adequate fidelity, without, at the same time, some sort of traditionary documents respecting the nations whence they had been received? In many of the theories framed for the occasion, this singularity has been overlooked; and, on the contrary, a tedious, and often very faulty parallel has been attempted, which, though vastly more striking than has ever yet been demonstrated, would, in the absence of other facts, be totally incompetent to any satisfactory conclusions. Unless in the case of merely arbitrary institutions, which cannot be traced to some original principles of human nature, either left to itself or placed in like circumstances, it seems more rational to ascribe resemblances to causes of universal operation than to specific and restricted agencies.

Variety of theories.—We have many examples of the strange conceits to which the neglect of this obvious truth has given rise in the mode of discussing the topic now adverted to; and hence, in a great degree, it has happened, as is noticed by Dr Robertson, that "there is hardly any nation, from the north to the south pole, to which some antiquary, in the extravagance of conjecture, has not ascribed the honour of peopling America." We could not think of abusing the reader's time or patience by a detail of the different theories, to all of which it is possible to assign some serious, and, perhaps, insuperable objection. The historian just quoted was apprehensive he should offer an insult to the understanding of his readers, if he attempted either minutely to enumerate or to refute these theories. We agree with him on the inexpediency of refuting most of them; for the simple statement of their nature is sufficient proof of their absurdity. But, on the other hand, it is clear, that an enumeration, so far from being unnecessary, can scarcely fail to have a salutary effect in repressing the extravagant propensity of human genius, where there is no legitimate guide to controul its operations.

Connexion of the two hemispheres.—The first theory we shall mention supposes the former connexion of the eastern and western hemispheres; and, that previous to its being broken up by some convulsion of the earth, the inhabitants of America, derived in common course from the original pair of human beings, had been settled in their present abodes. Certain islands in the Atlantic ocean are conceived, by this theory, to be remains of the portion of land by which the connexion was established.

The Americans escaped the deluge.—Somewhat similar on the whole, though differing in important particulars, is another opinion, that the original inhabitants of this continent, derived also from Adam and his consort, found means to escape the deluge by which all the rest of mankind, with the exception of Noah and his family, perished. According to this theory, then, the native Americans are the most ancient people on the earth.

Distinct pairs of human beings.—It is the leading peculiarity in a third theory, that there were two creations of mankind, or two separate pairs employed in their production, and that the western hemisphere was allotted to one of these, as the eastern hemisphere was to the other. To the most of minds which support this system, it is of course easy to account for the vastly superior productiveness of the latter, as well as for their greater success in all the arts and institutions of life. They can readily imagine, for example, that the transatlantic couple did not begin to exist till a few centuries before they were discovered by their ancient prototypes. With no less facility it can be conjectured and proved, that there is a natural tendency in some soils to bring forth human beings; and that, therefore, neither America, nor any of the numerous islands of the South sea, lying at the distance of many hundred leagues from a continent, are indebted to an external cause for their population.

Contiguity of America and Asia.—Not quite so splendid is the theory, that as America and Asia are either united together towards the north pole, or are within a very inconsiderable distance of each other in the northern latitudes, so the inhabitants of the latter would find little or no difficulty in finding their way to the former by land, or in such coasting vessels as are in common use among savages. Of the vicinity of these continents there can be no doubt; and it is even probable that the distance, short as it is, was formerly shorter, since some of the islands lying in the vacant space, exhibit vestiges of a peninsular junction. A comparison, besides, between the people and animals found in the corresponding regions of these two continents, is asserted to yield force to the notion of such transportation. But it is not denied, that difficulties almost insurmountable present themselves in the way of the theory, especially respecting the people of South America, who cannot, by any ingenuity be made to assimilate to any of the tribes of North America, far less to any of the northern nations of Asia. This theory, after all, has many supporters, and certainly will never want a semblance of truth.

America peopled from Europe.—There is something almost equally plausible in the opinion, that Europe has supplied the western continent with its inhabitants. Accordingly, we are furnished by its advocates with accounts of Norwegians, Swedes, and Welsh, having early ventured over the intervening ocean, and planted colonies on the regions visited by them. These accounts, it is certain, would be quite satisfactory, provided they were true. But in the absence of certain evidence to this effect, every sensible reader, we presume, that is neither Norwegian, Swede, nor Welshman, will feel disposed to decline giving his sanction to the conclusion.

Population of America.

Very similar observations may be made on the claims feebly advanced in favour of some of the ancient maritime people that dwelt on the shores of the Mediterranean sea, as the Carthaginians and Phœnicians. Nor is there any unjustifiable scepticism in the rejection of certain superlatively absurd speculations by Adair, Endicot, Elliot, and others, which go to prove that the Jews are the primitive inhabitants of America.

Peopled from Africa.—Circumstances brought to light in the progress of navigation and geographical discovery, have led, in modern times, to the conjecture, that the southern continent of America might accidentally have received visitors from the opposite coast of Africa. It is demonstrable, that the trade winds, and the gulf stream as it is called, which is influenced by them, are quite adequate to the transmission of vessels across the Atlantic ocean; and we have already made mention of the unexpected discovery of the coast of Brazil, by a Portuguese fleet, destined for India by the Cape of Good Hope, and which had stood farther out to sea than was usual at that period. It is therefore quite credible, that imprudence, ignorance, or accident, might have occasioned perhaps more than once the involuntary and reluctant passage of the intermediate ocean to the puny navigators of the African coast. Nor would it at all be a valid objection to this opinion, that we have no records of the fact, nor any allusions in ancient writings to such an apparent loss of any individual expedition as might be rationally accounted for by the supposition adduced. The people, in fact, most likely to have been exposed to the adventure, those dwelling on the south-west parts of Africa, were too little known to have their operations related by foreigners, and too little advanced in civilization to have historians of their own. If, again, it be inquired, whether there are any examples of similar accidents having happened in other parts of the world, the answer is decidedly in favour of the theory. We are immediately referred to the history of some of the South sea islands. Thus, without going as far as Bougainville, who asserts the inhabitants of the Society isles to have made voyages of 300 leagues, we learn, beyond all contradiction, in the narrative of our own navigator Cook, to mention no other authority, that cases of canoes having been driven to very great distances from their destination are not uncommon in the traditionary reports prevalent among the people of those islands. The theory, then, rests on something more durable than arbitrary assumptions; and certain points of resemblance between a people recently discovered in Africa, and some of the natives of America, have given it a speciousness which is at least equal to the recommendations of any of the other theories proposed.

Peopled from all the old continents.—The last opinion of which we shall speak embraces all the facts which have been alluded to, and deduces from them the conclusion, that America has in reality been peopled from every one of the old continents, and that certain distinct peculiarities are sufficient to indicate their respective origins. Thus, the Esquimaux of the north, for example, are asserted to have affinity with the Asiatic Samoieds and European Laplanders; the Araucans, Peruvians, and perhaps we may add Mexicans, are conceived to derive their origin from Asia; and most of the savage tribes which peopled South America, are supposed to have proceeded from Africa in the manner already described.

Population of America.

Probable deductions.—On the whole, it seems obvious, that to restrict the probability of having peopled America to one of the old continents only, as Asia, for example, is very injudicious and unphilosophical. There is no necessity for narrowing the question in this manner, and, at all events, it is positively absurd to confound together the really distinct characteristics of the numerous natives found in America, unless we can point out satisfactorily, and by some sort of illustration, how, on the supposition of their identity of origin, such remarkable differences have taken place. Let us, at least, have one region for the parent of the North Americans, and another for the inhabitants of the southern continent, and let us prosecute inquiries into the appearances, the languages, the manners and sentiments of different people, till we discover, what is always entitled to weighty consideration, some peculiar and striking resemblance. This has been done to a certain extent already, but the premises are not yet of magnitude or consequence enough to justify decisive conclusions. The reader will see examples of it in Mr Pinkerton's Geography. Thus, we cannot help thinking the following remarks, with respect to the partial claims of Africa, deserve notice: " Copper-coloured tribes, with lank hair, have been discovered in Africa, but in no other quarter of the world; and it is well known, that this colour is esteemed peculiar to the American indigenes, while the southern Asiatics are tawny or olive."—" The numerous human sacrifices, and other cruelties of the American indigenes, strictly infer an African origin, no such practices being found among the Asiatic tribes." This statement, however, is to be received with qualifications, and in fact, as must be known to every reader, is not true. " The oblique eye of the eastern Asiatics, who, according to theory, ought to have peopled America, is no where to be traced on that continent." " The beard of the indigenes of America is thin and woolly, like that of the Africans; while that of the oriental Asiatics is thin, but strait and strong."—" The Natches of Florida say, that their ancestors came from the rising sun, or east; that the voyage was long, and the persons in danger of perishing, when they discovered America."—" The natives of the Canaries are said to have been extremely tall, and may perhaps have been the ancestors of the Tehuels, called by Europeans Patagons, who always bury their dead on the eastern shores, as looking towards the country of their ancestors."—" The initial sound *Mb*, as *Mbao*, so common in Paraguay, &c. seems only known to the African and American enunciation; and it also appears in the Coptic, which is asserted by the best judges to be a peculiar and indigenal idiom, and not a dialect of the Assyrian." Vol. II. p. 510. third edition. This author, we may add, appears to have bestowed much attention to

Population of America.

this difficult question, and to have come to the conviction which we have stated in the last theory enumerated.

Character of the native Americans.—We shall conclude with a very general description of the most remarkable peculiarities of the American tribes. The subject must already be made familiar to most readers, by the almost universally perused works of Robertson and other authors.

Size and form.—The native Americans, in general, do not differ in size from Europeans. The exceptions are the Esquimaux, on the one extremity, and the Patagonians on the other. They incline to be round, or of full body, and have therefore a plumper appearance than is commonly met with in the Old World. It is not certain whether this depends on peculiarity of constitution, or mere indolence of life in the possession of abundant nourishment. Both causes may contribute to the effect. That some influence may properly be ascribed to the former, is manifest from the circumstance of their thicker skins, as proved by anatomical examination. But it is not unlikely that even this peculiarity is the result of their mode of living, and the practice of covering their bodies with various oily and colouring substances.

Colour.—The usual complexion of the native Americans is a sort of pale brown, designated by the name of copper-colour, which prevails, with very inconsiderable exceptions, throughout the whole of the continent. Not a single negro was found in the New World at the time of its discovery by Europeans. This singularity of colour, and the absence of black men in latitudes corresponding with those in the Old World, where they prevail, must ever present a formidable obstacle to the opinions respecting the original population of America.

Hair.—A notion long existed that the Americans had no beards, and that their heads alone were covered with hair. This defect was ascribed to a debility of constitution, by which they were supposed to be rendered very inferior to the inhabitants of other countries, both in mind and body. But the observation was hasty. It is distinctly ascertained that they are not naturally defective in this appendage, but that it is a very common, almost an universal custom among them, to extract the hairs by the roots wherever they appear, with the exception of a tuft on the top of the head, which is regarded as an ornament. Their hair is usually thick and smooth, and seldom inclines to curl.

Features and expression.—In point of features, the Americans cannot be said to be handsome or elegant, according to European prepossessions. Their faces are round, their foreheads small, the extremities of their ears are far from the face, they have small eyes, generally of a black or chesnut colour, with flat noses and thick lips. An indication of mildness discoverable in their countenances at a distance, is unpleasantly contrasted with a jealous and somewhat sulky expression, which strikes a spectator on more close examination.

No deformities.—The rarity, or indeed complete absence of deformities and lamenesses among the Americans, so early noticed by their visitors, is accounted for on reasons very different from any superior healthiness of constitution, or the greater facility of parturition. The fact seems to be, that such children as are likely, from any defects or weaknesses, to prove burdensome to their parents, or unfit for their own preservation and the services of the tribe, are put to death soon after they are born.

Aged and useless destroyed.—It is on a similar principle that those of their number who have survived their strength, and the capability of joining in martial operations and the fatigues of the chace, are deprived of existence, by what is considered the pious interference of their nearest relatives.

Morality and Religion.—From such specimens, it is scarcely necessary to remark, we may safely infer the low state of civilization among the American tribes, though by no means the absence of all moral feeling and sentiment. We have, on the contrary, unequivocal evidence of their general belief in the existence of some being to whom they are responsible for their actions, and of a sense therefore of right and wrong, however erroneous may be their notions of virtue, or imperfect their obedience to its dictates. Marriage is instituted and respected among them, though females are not in esteem, and are subjected to almost intolerable slavery. Religious rites, of some sort or other, are almost universally practised, in order to avert calamities, or obtain favours. The belief of a state of immortality, when the present life is ended, is the solace of their sorrows, and promises the highest reward of their hardships and valour. But it is associated, as might be expected, with the grossest notions of happiness, and, still more unfortunately, is productive of a savageness of disposition, which cannot be satisfied without the most wanton torture of their unfortunate enemies.

When discovered, they were almost perpetually occupied in war, or the pursuit of wild animals, on which they were dependant for their subsistence. They had, consequently, little or no time to cultivate the arts of peace. A few manufactories, as of a kind of coarse cloth, matting, and baskets, were found among them. They were so far advanced, however, in taste, as to be fond of decorations, and had sensibility enough to be delighted with such music, poetry, and dancing as their ingenuity had invented. Their eloquence, when it came to be understood, was much extolled, because, in fact, being the energetic expression of simple but strong feelings, it was naturally sublime. Great changes, it is reasonable to imagine, have taken place among them since their intercourse with people much more improved than themselves. Their alliance has often been courted by European nations engaged in hostilities with each other, or anxious to obtain secure possession of their favoured regions. In these connexions, fidelity and treachery, bravery and cowardice, magnanimity and meanness, have been repeatedly and singularly combined. On the whole, they appear to have bee little benefited by the labours, whether political o r religious, of their European associates, for the advantages thence derived have almost invariably been accompanied by a participation in one destructive vice, that of drunkenness, which, without any other evil, is amply sufficient to degrade even the worst characteristics of savage life.

AMERICAN Night Shade, the name of some of the species of plants included under the genus Phytolacca.

American Ground Nut, a species of plant included under the genus Arachis.

AMERICUS Vespucius, the navigator whose name the vast continent of America now bears, although his visit was posterior to the time of its discovery by Columbus. See Vespucci.

AMETHYST, a coloured variety of rock-crystal. The colour, which is purple or red, of different shades, seems to depend on iron or manganese, or a mixture of both. See Mineralogy.

AMETHYSTEA, a genus of plants belonging to the class Diandria, and order Monogynia.

AMHAR, or Amhara, a district or province of Abyssinia, which is distinguished by being long the residence of the royal family and many of the nobility, and by the prevalence of a peculiar dialect, called the Amharic, which is adopted as the court language. This province is an elevated region, which includes the lofty mountain, or Ambageshen, the place of confinement of the younger branches of the royal family, to prevent their interference with the affairs of government. But although the Amharic dialect be regarded as the polite and fashionable language, all the books are written in the Ethiopic or Geez; and, by a traditionary law, destruction is denounced against any one who shall attempt to translate the Scriptures into any other language.

AMIANTHUS, a variety of asbestus, which is included under the magnesian genus of minerals; and from its fibrous structure, and flexible and incombustible property, it was employed by the ancients in the manufacture of their celebrated incombustible cloth. See Mineralogy.

AMICABLE Numbers, denote pairs of numbers, each of which is mutually equal to the sum of the aliquot parts of the other. This name was applied to such numbers by Schooten, although these numbers had been previously investigated by Rodolphus, Descartes, and others. The numbers 220 and 284 form the first or least pair of amicable numbers. Thus, the aliquot parts of 220 are 1, 2, 4, 5, 10, 11, 20, 22, 44, 55, 110, and their sum is equal to 284; and the aliquot parts of 284 are, 1, 2, 4, 71, 142, and their sum is equal to 220. The second pair of amicable numbers are 17,296 and 18,416; and the third pair are, 9,363,584, and 9,437,056. See *Hutton's Mathematical Dictionary*, and *Leybourn's Mathematical Repository*.

AMID-AMID, a lofty ridge of mountains in Abyssinia, supposed by some to be a continuation or branch of the Mountains of the Moon of the ancients; but this is considered by others an erroneous opinion; and indeed it may be added, that no precise information of the Mountains of the Moon has yet been obtained. The ridge of Amid-Amid is particularly described by Mr Bruce.

AMIDA, an ancient city of Mesopotamia, situated on elevated ground on the river Tigris, and on the borders of Assyria, is now under the dominion of the Turks, and its modern name is Diarbekir.

AMIENS, formerly the capital of Picardy, and now of the department of the Somme, in France, is finely situated on the banks of a river, from which the department derives its name. Amiens was a place of considerable note in the time of the Romans, and was occasionally selected as the residence of some of the emperors. The Somme is navigable to Amiens, and three branches of that river traverse the city. The streets and squares are spacious, and many of the public buildings are distinguished by their elegance. The cathedral, with its beautiful paintings, fine pillars, and numerous chapels, is greatly admired as a magnificent Gothic structure. The population exceeds 40,000; and manufactures of linen, woollen, and soap, are established in the town. The definitive treaty of peace which was entered into by the different European powers was concluded at Amiens in 1802. Amiens is 90 miles N. from Paris, and 106 miles S. from Calais.

AMLWCH, a sea-port town in the island of Anglesea, in Wales, which, since the year 1768, has risen from a small fishing village to a town of 5000 inhabitants, owing to its immediate vicinity to the celebrated copper mines in Parys mountain. The harbour is an excavation of the solid rock, sufficiently capacious to admit thirty vessels of 200 tons burden each. It was dug out at the expence of the copper mining companies, for the exportation of the produce of their mines.

AM-KAS, a spacious saloon in the palace of the Great Mogul, where he appears, on solemn festivals, in all the richness and parade of oriental magnificence.

AMMANIA, a genus of plants belonging to the Tetrandria class, and order Monogynia.

AMMI, Bishop's Weed, a genus of plants belonging to the Pentandria class, and arranged with the natural order of *umbelliferous* plants.

AMMIANUS, Marcellinus, a Roman historian, was a native of Antioch in Greece; in early life entered into the military profession; and about the year 370, as an officer of horse, accompanied the emperor Constantius in some of his eastern expeditions. His history, which was composed at Rome, commences with the reign of Nerva, and is continued to the death of Valens, originally extended to thirty-one books, of which the first thirteen are lost, and is so distinguished for candour and impartiality, that the historian of the Decline and Fall of the Roman Empire pronounces the author to be "an accurate and faithful guide, who composed the history of his own times without indulging the prejudice and passions which usually affect the mind of a cotemporary." He died about the end of the fourth century.

AMMODYTES, or Sand-eel, a genus of fishes which appear in great shoals on many of the shores of Britain. See Ichthyology.

AMMON, or Hammon, the Jupiter of the Egyptians, by whom he was worshipped under the figure of a ram. Mythological history traces the origin of the name to Bacchus, whose army traversing the Assyrian desarts, and almost perishing for want of water, was relieved by Jupiter in the shape of a ram, who conducted them to a copious spring. In grateful remembrance of the kind interposition of his father, Bacchus erected a temple on the spot, and consecrated it to Jupiter-*Ammon*, from a Greek word which signifies *sand*, and is thus expressive of the scene of the event. But, according to annotators on Scripture, the Egyptian Ammon ought to be referred to Ham, the son of Noah, whose history seems blended and obscured with heathen mythology; for the Hebrew word Ham, and the Greek appellation of Jupiter, are derived from words of the same meaning, and which signify *to be hot or warm*. Egypt was called in Hebrew, *Mizraim*, supposed to be from Mizraim the son of Ham, and also *Chemia*, from Cham or Ham; from all which it is concluded that Egypt was peopled by the son or grandson of Noah, and that the nation, always inclined to idolatry, had instituted a system of worship to the founder of their race, under the name of Ammon, and from them the same religious system was extended to Greece.

AMMONIA, one of the three alkalis, properly so called, and, from its volatile nature, denominated *volatile alkali;* and in the older language of chemistry and pharmacy, *spirit of hartshorn*, and of *sal ammoniac*, names expressive of its origin; has been long known as a compound of hydrogen and azote, which the brilliant galvanic discoveries of Sir Humphry Davy have shewn to be in combination with a metallic base. See CHEMISTRY.

AMMONIAC, a gum resin which is extracted from a plant belonging to the genus *ferula*, one of the umbelliferous tribe, and derives its name from the temple of Jupiter-Ammon in Egypt, in the vicinity of which the plant grew spontaneously. The same plant is also a native of some parts of Persia. See MATERIA MEDICA.

AMMONIAC, *Sal*, a neutral salt, composed of ammonia and muriatic acid, and hence called *muriate of ammonia*, was originally obtained from the excrementitious matters of camels which were employed by those who visited the temple of Jupiter-Ammon in Egypt, and to this the name is ascribed, is extensively employed in various arts, which are now supplied with it from manufactories established in most parts of Europe. See SALTS.

AMMONITÆ, or AMMONITES, or *Cornu Ammonis*, a genus of univalve shells, which are always found in the petrified state, and generally in limestone or sandstone strata, and, like many other animal and vegetable petrifactions, have not been discovered in the recent state, from which it is concluded that the species are entirely lost.

AMMONITES, a people who inhabited Syria, and were descended from Ammon, the son of Lot. The history of this people, as it is recorded in Scripture, and by Josephus, notices their conquest of a gigantic race who dwelt in the mountainous regions of Gilead, and the occupation of their territory; the command of God to the Israelites, not to disturb the children of Ammon, or to make any encroachment on their possessions; their demand for the restitution of part of their territory, long held by the children of Israel, and taken from the Ammonites by Moses; their entire defeat by Jephtha; their hostile aggressions in the time of Saul and David, and their subjection to the kingdom of Israel; their attempts to throw off the yoke by an alliance with the Moabites, and repeated invasions of the kingdoms of Israel and Judah; their complete discomfiture and second subjection; their dispersion by Nebuchadnezzar, and restoration by Cyrus, after the destruction of Jerusalem by the Romans; their distinctive appellation lost in the more general denomination of Arabians; and, before the end of the third century, no trace of their name in existence, thus verifying the prophecy of Ezekiel, which declares, that they should "not be remembered among the nations." Deut. chap. ii. Judges, chap. ii., 2 Sam. chap. x. & xi., Ezek. chap. xxv., and Joseph Antiq.

AMMONIUS, surnamed SACCAS, a native of Alexandria, who flourished about the beginning of the third century, is celebrated as the founder of a popular system of philosophy, the object of which was to select from the prevailing systems, and especially from those of Plato and Aristotle, such tenets and doctrines only as commanded universal assent, and to reject all such as were obscured with doubt, or were susceptible of controversy. This system was distinguished by the name of Eclectic philosophy, from its accommodating and plausible nature, was at first very generally received, continued long to arrest attention and command approbation, and its author obtained the dignified designation of heaven-taught. But the attempt to reconcile the jarring opinions of the ancient philosophers, and to combine the maxims and morals of the heathens with the doctrines of Christianity, was too arduous to be followed with success, and the complying spirit of the system was ill calculated for the investigation of truth.

AMNESTY, an act by which offences against any government or state are declared to be annulled and forgotten. The word is derived from the name of an edict of a similar nature, which was published by Thrasybalus, after the expulsion of the tyrants from Athens.

AMNIOS, or AMNION, a thin pellucid membrane which forms the internal covering of the foetus in the womb.

AMNIOTIC ACID, a peculiar acid which is obtained in a concrete state by evaporating the *liquor amnii*, or waters of the amnios.

AMOMUM, or Ginger, a genus of plants belonging to the class Monandria, and order Monogynia.

AMONTONS, WILLIAM, an experimental philosopher, was born at Paris in 1663, and from his earliest years was afflicted with deafness, a calamity which, it is alleged on doubtful information, he did not regret, and even declined any attempts to alleviate or remove; for, while such a misfortune excluded him from one of the chief sources of social enjoyment, it enabled him at the same time to concentrate the powers of his mind, and to direct them with less distraction to geometrical and mechanical studies, which became his favourite pursuits, and can only be successfully prosecuted with vigorous thought and assiduous attention.

The discovery of the perpetual motion, that airy phantom of false philosophy, which has often occupied the minds of men in fruitless efforts of ingenuity, and even at the present day is sought for by some in powers of magnetic attraction and repulsion, was one of the first speculative investigations of Amontons; and he indulged the vain hope, that the aid to be derived from mathematical principles would enable him to accomplish it. But his labours were more usefully employed in furnishing plans for public works, and in superintending their execution, for which the practical applications of his mathematical knowledge supplied him with the necessary qualifications. The invention of the telegraph for promoting speedy intelligence, a discovery not unknown to the ancients, although the moderns are disposed to arrogate it to themselves, and the invention and improvement of various meteorological instruments, of which an account is detailed in his "Observations on Barometers, Thermometers, and Hygrometers," are also enumerated among his valuable researches; while the numerous memoirs on kindred subjects, which he contributed to the volumes of the Academy of Sciences, of which he was a member, farther attest the extent of his industry and ingenuity. He died in 1705.

AMORITES, a people of Syria, who were descended from the fourth son of Canaan, and who originally occupied the mountainous regions to the westward of the Dead sea, are described by the prophet Amos as a race of gigantic stature, and of great valour, under the bold comparison of being tall as the cedar and strong as the oak. The same name appears to be extended to the whole inhabitants of Canaan. The Amorites were formidable enemies of the Israelites in their journey to the promised land; and the refusal of their king, Sihon, to grant the request made by Moses, to permit his countrymen to pass through his territory, under an engagement that his subjects and their property should be secured from injury, was followed by the total discomfiture of his forces, and his own death in the conflict, and by the distribution of his possessions among the tribes of Judah, Reuben, and Gad. Numb. chap. 13. Joshua, chap. 5. Judges, chap. 11.

AMORPHA, False Indigo, a genus of plants belonging to the Diadelphia class.

AMORTIZATION, or AMORTISEMENT, is the act by which lands or tenements are alienated or transferred to a corporation, or are turned into mort-main.

AMOS, the fourth of the minor prophets, lived about 780 years before Christ, was cotemporary with Hosea, and in early life had been a herdsman at Tekoah, four leagues distant from Jerusalem. The prophetic remonstrances of Amos are directed against the idolatrous worship and wicked lives of the people of Israel and Judah; they distinctly foretel the calamitous captivity of the ten tribes, and expressly declare their future restoration under the Messiah. The language of this prophet abounds with illustrations drawn from the pastoral life, with the habits of which his early occupation rendered him familiar. Applying the words of St Paul, "rude in speech, yet not in knowledge," to Amos, Jerome pronounces the language of the prophet to be deficient in grandeur of thought and elegance of expression; while a modern commentator, Bishop Lowth, is of opinion, that in sublimity of sentiment, beauty of composition, and splendour of diction, he is inferior to none of the prophets.

AMPELIS, a genus of birds belonging to the order of Passeres, and of which one species, *Garrulus*, the chatterer, sometimes appears in the northern part of the island. See ORNITHOLOGY.

AMPHIBIA, the third class of animals in the Linnæan arrangement, includes reptiles, serpents, and cartilaginous fishes. Some of the animals comprehended under this class possess the peculiar power of supporting life sometimes on land and sometimes in water, as the frog and crocodile; and hence the name of the class, descriptive of this character, is derived. See ERPETOLOGY and OPHIOLOGY.

AMPHIBRACHYS, which signifies "short on both sides," is the name of a foot in Latin and Greek verse, which is composed of three syllables, of which the middle syllable is long, and the first and the last are short, as *ămārĕ*, *ăbīrĕ*.

AMPHICTYONS, the deputies of the chief states of Greece, who formed a general council, to which were entrusted the regulation and superintendence of all the civil and religious affairs of the country. The original institution of this assembly is variously traced, to Amphictyon the son of Deucalion; to Acrisius king of the Argives; to a convention of the neighbouring states, which met at a very early period of the Grecian history at Delphi; and to the Hellenes, who were the founders of the oracle at Dodona, and the supposed authors of the more celebrated Delphian establishment. This assembly, which first met at Thermopylæ, but generally at Delphi, consisted of 30 members in the time of Antoninus Pius; but the number of deputies seems to have varied from ten to twelve, as the number of states admitted into the alliance was greater or smaller. Two deputies, it is said, were sent from each state; one of whom, elected by lot, was charged with the care of all matters connected with sacrifices and religious ceremonies; the other, chosen by the majority of the citizens, seems to have been employed in a judicial capacity, to hear and decide causes between private persons; but both were invested with the power of deliberating on the general interests of Greece.

A solemn oath, sanctioned by the most dreadful imprecations on those who should be guilty of its violation, was administered to the members on their admission; and the commencement of their deliberations was preceded by the sacrifice of an ox, which was cut into small pieces, as a symbolical expression of their union. The spring and autumn were the stated times for the meeting of the assembly of the Amphictyons; but on extraordinary occasions they were summoned at any time; and occasionally, when the affairs of the country required it, their deliberations were permanent throughout the year.

AMPHIMACER, a metrical foot in Latin poetry, composed of three syllables, of which the middle syllable is short, and the first and the last are long, as *cāstĭtās*.

AMPHION, who is represented in the fabulous history of Greece as the son of Jupiter and Antiope, the daughter of a king of Bœotia, and celebrated for his eloquence and skill in music, is supposed to have been a prince or ruler of Thebes, and having contributed greatly to the civilization and improvement of his countrymen, by the wisdom of his political institutions and the prudence of his government, is described in the fictions of the poets as moving the rocks, and arranging the stones into regular order to form the walls of the city. The same fiction has furnished a beautiful ornament to succeeding poets, and the art of Amphion is a synonymous expression with the art of music.

AMPHION is another character in ancient mythology, who was the son of Jasus, king of Orchomenos, and, according to Ovid, was the husband of Niobe, the daughter of Tantalus. Seven sons, and an equal number of daughters, the offspring of this marriage, rendered Niobe vain of her numerous family, and tempted her to treat with derision and contempt Latona, the mother of Apollo and Diana, because she had only two children. The affront and insolence with which their mother was treated were resented by the god and goddess, who in revenge slew the children with their arrows. The male children were destroyed by Apollo, and the female by Diana. Niobe herself, struck dumb with grief and despair, appeared like a senseless statue, and no doubt gave origin to the poetical fiction of her transformation into stone. This interesting story is beautifully related in the sixth book of the Metamorphoses of Ovid. The statue of Niobe, which is still admired as one of the most extraordinary specimens of ancient sculpture, is ascribed to the celebrated Grecian artist Praxiteles, in an epigram written in Greek by an unknown author, of which the following is a translation:

> While for my children's fate I vainly mourn'd,
> The angry gods to massy stone me turn'd;
> Praxiteles a nobler feat has done,
> He made me live again from being stone.

AMPHISBÆNA, a genus of serpents, which has this denomination because the species of which it is composed have the power of moving forward either with the head or tail. See OPHIOLOGY.

AMPHISCII, a name which is applied by geographers to the inhabitants of the torrid zone, because, as the name denotes, their shadow is towards the north during one part of the year, and towards the south during another.

AMPHITHEATRE, a spacious edifice erected in the latter ages of the Roman republic for the exhibition of public spectacles. Amphitheatres were originally constructed of wood; but about the time of Augustus, when they began to approach to that extent and magnificence which they afterwards attained, the more substantial and durable material of stone was employed. The largest structure of this description, and which became the model of similar buildings throughout the Roman provinces, was the amphitheatre at Rome, which was begun by Vespasian and completed by Titus, and has been distinguished by the name of *Coliseum*, the remains of which still exist, and exhibit one of the most sublime and perfect specimens of ancient architecture.

The Coliseum is of an oval form; the longest diameter is about 615 feet, and the shortest about 510. The arena, or middle space, on which the spectacles were exhibited, is about 284 feet in length, and 176 feet in breadth. The surface covered by the whole structure is not less than $5\frac{1}{2}$ acres. The building consists of three stories, the first about 33 feet in height, the second about 39, the third about 38 feet, and the pilastrade, which incloses the whole, is about 46 feet. The entire height, including the blocking course and the steps, is about 164 feet. Arched passages were constructed for the accommodation of the spectators. Four of these entrances were more spacious than the rest; two of which were reserved for the emperor, the senate, and other distinguished personages, and the other two were destined for the gladiators and animals which were to be exhibited on the arena. This magnificent and immense structure, which was capable of admitting 80,000 spectators, and, according to some accounts, more than 100,000, it is said, was completed in the short period of two years and nine months; and, if this be true, it is impossible to conceive a more remarkable instance of the wealth and resources of the Roman people.

The middle space of the amphitheatre, called the arena, because it was strewed with sand, was destined for the combats of gladiators and other spectacles. Surrounding this space were the cells for the wild beasts. Above the lodges or cells, a gallery was constructed, which was appropriated to the senators and other persons of distinction; and one part of the gallery, on which was erected a throne, surmounted by a canopy, and richly decorated, was reserved for the emperor. The other parts of the edifice were occupied by the people, according to their rank; and as the seats or benches, some of which were covered with wood, and others with cushions, rose gradually from the circuit of the arena to the top of the building, every individual of the assembled multitude saw distinctly the spectacles exhibited. The amphitheatre was open to the sky; but to protect the spectators from the sun and rain, an awning or curtain was occasionally employed.

It is not less to be regretted than wondered at, that Michael Angelo, one of the most celebrated artists of his age, should have aided the ravages of time in the destruction of the Coliseum, by removing great part of the outer-wall to procure stones for the construction of the Farnesian palace. With a more liberal spirit, Pope Benedict XIV. consecrated those venerable remains of antiquity, and erected a number of altars within the ruins, which thus became objects of pious respect; and still more effectually to secure them from future dilapidation, a hermit, whose cell occupied a small structure in the middle of the pile, was appointed to watch over the building.

Similar buildings were erected in other parts of the Roman empire, as in Jerusalem and in Cesarea, at Verona, Pola in Istria, and at Nismes in France. The amphitheatre at Verona consisted of three stories, and was 90 feet in height, covering a surface of more than four acres; no cement was employed in this building; the stones were united with iron cramps, which were covered with lead, to prevent the corrosion of the iron. Amphitheatres were sometimes constructed on the declivity of hills, by forming benches of stone or turf, and completing the oval form by works of stone at the extremities. Traces of an amphitheatre, in which the benches were of turf, have been discovered in the vicinity of Sandwich, in Kent; and similar temporary struc-

Amphora. tures, it is probable, were erected near camps and military stations in the distant provinces.

The first combats of gladiators which are recorded by historians, were exhibited in Rome, in the 490th year of the city, by the sons of Brutus, at the celebration of their father's funeral. Twelve years afterwards, the introduction of wild beasts, which afterwards formed a considerable part of these spectacles, took place, when the elephants, which were taken from the Carthaginians in Sicily, were exhibited by Lucius Metellus. The strong desire which the Romans expressed for these barbarous amusements, and the high gratification which they seem to have afforded, induced those who courted popular favour to expend enormous sums, with the view of surpassing their rivals or competitors in the splendour and magnificence of the exhibitions. The circus, a temporary structure, in which such spectacles were first exhibited, was neither convenient nor safe for the spectators. The inconvenience of seeing, which was experienced in the circus and succeeding temporary structures, the accidents which sometimes happened, when they were not of sufficient strength, and the danger to the spectators from the infuriated wild animals, finally led to the design of erecting amphitheatres of a commodious, safe, and durable construction, when those barbarous exhibitions, the delight of the Roman people, reached their highest perfection. At the opening or dedication of the Flavian amphitheatre, or Coliseum, 5000 wild beasts, according to the account of one historian, but according to another 9000, were destroyed. When the combats of these ferocious animals were concluded, the arena was instantly filled with water, presenting the appearance of a lake, into which aquatic animals were introduced to attack and destroy each other; these scenes were succeeded by a number of vessels, which represented a naval engagement. The triumph of Trajan over the Dacians was celebrated by the exhibition of every variety of these spectacles, which continued for four months, and in which a thousand gladiators were engaged, and 11,000 animals were doomed to destruction. Slaves, malefactors, and captives taken in war, were originally condemned to the horrid occupation of gladiators. Professional persons were afterwards trained and devoted to this service; and sometimes men of rank, and even, it is said, women, desirous of signalizing themselves in these bloody conflicts, entered the lists. In the beginning of the fifth century of the Christian era, the combats of gladiators were suppressed in the Roman empire; but the combats of wild beasts were permitted nearly a hundred years longer. In the middle ages, when chivalry flourished, the amphitheatre was chosen for the exhibition of judicial combats, tilts, and tournaments. Since the neglect and abolition of these rude amusements, the inventive genius of man has discovered no use for these huge buildings.

AMPHORA, a measure of capacity used by the Greeks and Romans. The Roman amphora for liquids was nearly equal to seven gallons and one pint English measure; the Grecian amphora contained a third more. The same name was applied to a dry measure among the Romans, the capacity of which was equal to about three bushels.

Amsterdam.

AMPLIFICATION is applied, by rhetorical writers, to that part of an oration or discourse in which the circumstances which accompany any event are enlarged upon, or minutely detailed, for the purpose of exciting strong emotions in auditors or readers.

AMPLITUDE is a term employed by astronomers to denote an arch of the horizon, intercepted between the east or west point, and the centre of the sun, or a planet at rising or setting.

AMSTERDAM, the chief city of Holland, stands at the confluence of the river Amstel with a branch of the Zuyder sea. In the beginning of the 13th century, a few huts, the miserable abode of poor fishermen, were all that occupied the place of this city, which its favourable situation for commercial enterprize, and the industry and activity of the inhabitants, have raised to the first rank for wealth and population. But in its progress to this pre-eminence it has not escaped various severe disasters. In the early period of its history it was frequently exposed to the attacks of its neighbours, against whose incursions it was surrounded with a brick wall in 1490; soon after it was nearly reduced to ashes by an accidental fire; in 1525, John of Leyden, the pretended king of Munster, headed a party of fanatics who had nearly possessed themselves of the city, but by the vigorous resistance of the inhabitants were overpowered, and almost the whole, to the amount of 600 men, were put death; ten years only had elapsed when another tumult, excited by the Anabaptists, whose object was to seize the government, disturbed the quiet of Amsterdam; but their frantic scheme, masked by religion, was defeated by the successful opposition of the citizens, and the fanatical insurgents were cruelly massacred; and as this city was one of the last which joined the confederacy, and embraced the reformed religion, an express stipulation for the free exercise of the Roman Catholic religion, in the conditions of surrender to the Hollanders after a siege of ten months, was most shamefully violated, and the unpardonable zeal of the Protestants burst forth and led to the expulsion of the monks, nuns, and priests, and the destruction of the emblems and altars of their worship.

Enlarged at different periods with its growing commerce and population, Amstersdam acquired, in 1675, twice its former extent, was surrounded with a wall and ditch, the latter eighty feet broad, and filled with water, and now covers a semicircular space more than nine miles in compass. A single gate forms the communication towards the shore, and eight towards the land side, all of which are massy buildings constructed of stone. Almost the whole of the city is built on piles of wood, which were required as a substitute for a solid foundation in marshy ground. The space which it occupies is traversed by numerous canals, and not fewer than 300 bridges facilitate the access to the different quarters of the city. The new bridge over the Amstel is a magnificent structure, consisting of 36 arches, some of which are very lofty, is 600 feet in length, and 70 in breadth, and affords a striking view of the sea, the harbour, Amsterdam. and the city itself. The streets of Amsterdam are in general narrow; but some of them, along the banks of the principal canals, can boast of the spacious breadth of 140 feet. Many of the private houses of the rich merchants are splendid edifices, furnished and embellished in the French style.

The stadthouse, which is always regarded as one of the most extraordinary buildings in the world, was begun in 1648, and in little more than eight years was completed at the enormous expence of two millions sterling, stands on 14,000 massy piles of wood, and is 282 feet in front, 255 in depth, and 116 feet in height. The external decorations of this building are bronze figures of Justice, Wealth, and Strength, with a colossal Atlas supporting the world, and some other statues; and it is surmounted by a tower 50 feet high, which is furnished with an excellent chime of bells, some of which are of large size. The internal ornaments of the spacious halls, and other apartments, are distinguished by their splendour and magnificence. The stadthouse is chiefly destined to the accommodation of the courts of justice, the public offices, and the municipal authorities. The prison occupies one of the courts of this edifice; and the apartments for the bank on the ground floor, it is said, contained 40,000,000l. sterling in bullion before the subjugation of Holland to France, during the revolutionary war. The admiralty, the arsenal, and the exchange, are also extensive and magnificent edifices.

The rasphouse is an establishment in which offenders are confined, and condemned to saw logs of wood, or to rasp Brazil and other dye woods; and those who are indolent or refractory are shut up in a cellar to which water is gradually admitted, and to save themselves from drowning they are obliged to work at the pump. The spin-house, or work-house, is a charitable establishment, as well as a place of punishment for petty offenders of the female sex. They are employed in sewing, and spinning wool, flax, and hemp. The numerous hospitals, and other charitable institutions, are supported partly by voluntary contributions, and partly by taxes on public amusements.

In the academy denominated the *Illustrious School*, the languages, philosophy, and divinity, are taught; and several respectable literary societies have flourished in Amsterdam.

Of the numerous churches, eleven belong to the Calvinistic or established form of religion, twenty-seven chapels are appropriated to the Roman Catholics, and two synagogues are destined to the Jewish worship, one of which is the largest in Europe. The new church, dedicated to St Catherine, is a magnificent building. The pulpit is greatly admired for its sculpture, the windows are adorned with paintings, and the organ is esteemed one of the finest in the world.

The civil administration of Amsterdam is intrusted to a senate or council of thirty-six members, who are chosen for life. The deputies sent to the states of Holland are elected by the senate, and by them are appointed the chief magistrates or burgomasters, who are twelve in number. From these, four are chosen to execute the duties of the office.

The trade of Amsterdam, before it experienced the severe checks during the French revolution, was prodigious. Its commerce extended to almost every part of the world, and it merited the appropriate title of the *storehouse of Europe*. The population, in 1806, was estimated at nearly 300,000. Amsterdam is 130 miles distant from Brussels, 150 from Liege, and 330 from Paris. N. Lat. 52° 22'. E. Long. 4° 45'.

AMSTERDAM, an island in the South Pacific ocean, discovered by Tasman, a Dutch navigator, and afterwards visited by Captain Cook; is 20 miles in length, and about 13 in breadth; is surrounded, like most of the islands in that region, with a coral reef; rises, even in its most elevated parts, but a few yards above the level of the sea; and the whole surface is laid out in plantations, which produce all the rich fruits of tropical countries. Yams, some other eatable roots, and sugar canes, were not uncommon. The natives appeared a brisk and lively race, with regular features, black hair, and fine eyes. The dress of both sexes consists of a piece of cloth, or matting, wrapped round the middle, and tattowing, or puncturing the skin is a prevalent practice. Cloth of various colours, and matting, of a finer fabric for dress and coarser for sails to their canoes, are manufactured. Their fishing implements resemble those of the other South Sea islands, and some of their smaller ornaments and domestic utensils are neatly executed. S. Lat. 25° 11'. W. Long. 173°. The same island is known by the native name of Tongataboo.

AMSTERDAM, an island in the Indian ocean, which was visited by some of the attendants of the embassy to China in 1793, is about four miles long and two miles broad, and is inaccessible except on the east side, where a tolerable harbour, with eight or ten fathoms depth of water, seems to have been formed from a volcanic crater. The soil, which is soft and spongy in most parts of the island, and in some places so hot as to prevent vegetation, the springs, which have a high temperature, are chiefly brackish, and the vapours which issued from numerous fissures, all indicate volcanic operations. No native inhabitants were found on the island when it was visited by the Lion man-of-war, with Lord Macartney and his suite, on their voyage to China; but three Frenchmen and two natives of England, who had emigrated to Boston at the end of the American war, were engaged in collecting seal skins for the Canton market. They had last come from the Isle of France, had resided five months in this sequestered spot, and had collected 8000 skins, nearly a third part of the cargo which they expected to complete in ten months more. Their vessel had sailed to Nootka sound, to procure sea otter skins, and was to call at Amsterdam island to take in the seal skins, all which were destined for the Chinese market. The *phoca ursina*, Lin. is the species of seal which is so abundant on the shores of this island as to become an important object of commerce. They are most numerous in summer, when they come on shore in droves of 800 or 1000, and a tenth part of the whole is killed by the five men, who could not skin and stretch out for drying a greater number. The sea abounds also with excellent fish, particularly a species of cod; a basket, with almost any kind of bait, let down into the sea, might be

Amulet || Ana. Anabaptists.

filled with cray fish in a few minutes; sharks and dog-fish of large size were numerous, and tench, bream, and perch were readily caught in the bason of the crater which forms the harbour, and being drawn out of the cold water, and immersed in a hot spring in the vicinity, they were completely boiled in about 15 minutes. The albatross, the black and blue petrel, and the sea-swallow, are the common birds which frequent Amsterdam-island. S. Lat. 38°, 42'. E. Long. 76°, 64'. St Paul's, a small island which lies in sight to the northward, is overspread with shrubs and trees of middling size, and is said to afford abundance of fresh water, but no good anchorage or a commodious landing-place could be discovered.

AMULET, a charm, or supposed preservative against disease or misfortune, which, under various forms, has prevailed among all nations during the darkness of ignorance and superstition; and, in more enlightened periods of society, is believed by some to possess a certain degree of efficacy. Amulets were worn about the neck, or attached to particular parts of the body; sometimes they were made of gems, metal, animal or vegetable matter; sometimes they consisted of words, characters, and sentences, arranged in particular order; and, even in the times of Christianity, the relics of saints, and ribbands, with texts of Scripture written on them, have been employed for the same purpose. Magic and astrology, which acknowledge a similar origin, have united their influence in providing certain kinds of amulets for the weak and superstitious.

AMYGDALUS, the almond and peach tree, a genus of plants belonging to the Icosandria class.

AMYRIS, shrubby sweetwood, a genus of plants belonging to the Octandria class.

ANA, a Latin termination, which has been adopted as a general title of certain works which profess to detail the unpremeditated thoughts and unrestrained sentiments of persons of learning and wit, as they are expressed in private conversation; and hence they are supposed to exhibit a just and lively picture of the characters introduced. How far these ends are attained by such collections, a slight notice of the history of some of them will shew. It has been said, that the title of these works is a word of doubtful origin; but it seems quite obvious, that the whole difficulty is at once solved by joining the word *dicta* to the name, which is converted into an adjective, as *dicta Walpoliana*, *dicta Scaligerana*; the sayings or remarks of Walpole, of Scaliger.

Works of this nature, it has been observed by those who have entered into their history, are not new. The deeds and sayings of Socrates were collected by Xenophon; and the maxims and precepts of Pythagoras, Epictetus, and other ancient philosophers, have been also recorded by their disciples and followers. It is said that Julius Cæsar formed a collection of anecdotes of Cicero, the celebrated orator; a freedman of Mæcenas, the great patron of literature in the Augustan age of Rome, recorded the sayings of his master; and the *Noctes Atticæ* of Aulus Gellius contain numerous anecdotes which the author gleaned from the distinguished characters with whom he associated. But it was not till the beginning of the 15th century that collections of this kind, with the mysterious title of *Anas*, or books in *ana*, made their appearance. One of the earliest and most celebrated of these works, is the *Poggiana*, which derives its name from Poggio Bracciolini, who was secretary to several popes. Poggio and his literary friends held frequent meetings, and conversed freely on every kind of subject; but as the investigation of truth, or intellectual improvement, was less the object of the assembly than a display of wit or licentious humour, whatever was the sacrifice, it is not difficult to appreciate such a work, especially when Poggio himself, the compiler, has denominated the place where the parties assembled, *Mendaciorum Officina*, or the shop of lies.

The *Scaligerana* was the first published work with this title, under which two collections have appeared, and profess to contain the remarks delivered in conversation by Joseph Scaliger, a professor of Leyden, and a profound classical scholar; but it is admitted that these collections are full of falsehoods, personal abuse, and silly, scurrilous, and obscene observations. But what shall be said of the freedom of conversation displayed in the *Segraisiana*, a collection which derives its name from Segrais, and which was compiled by a person concealed behind the tapestry in a house which he frequented? In such circumstances, with those at least who were in the secret, the flow of sentiment, and the current of conversation, could not be altogether uninterrupted. Voltaire has characterised the Segraisiana as the best entitled to all the works of this kind to be ranked among printed, and especially insipid falsehoods: but perhaps that celebrated wit had some reason for this strong expression of reprobation. The *Walpoliana*, which professes to exhibit the literary conversation of Horace Walpole, is one of the most recent of these productions, and one of the few which has appeared with this title in England. The plan of such a collection, it appears, was suggested to that accomplished scholar himself; but he wisely declined it, although, it is said, he supplied the editor of the collection with some of the materials of which it is composed. Part of it appeared after his death in a periodical publication; and the whole collection, supplied with new matter from various quarters, acquired considerable bulk, and was published in two volumes. Literary productions, whose origin and progress are such as have now been stated, can scarcely be free from mistatement and misrepresentation, if they are not entitled to a character of a more reprehensible nature.

ANABAPTISTS, a denomination which has been applied to religious sects of very different principles and practices. They first appeared in Germany, and excited serious commotions about the period of the reformation. The name signifies a person who is baptised again; and in this sense it is applicable to some sects in the earlier ages, who contended that those Christians of the Catholic church who joined themselves to their respective parties should be rebaptised. This denomination is rejected by the English and Dutch Baptists, who hold the baptism appointed by Christ to be nothing short of immersion upon a personal profession of faith, of which profession infants being incapable, and sprinkling being no adequate symbol of the thing intended, the baptism of proselytes to their communion, who in infancy had undergone that ceremony, cannot be, it is urged, considered a repetition of the baptismal ordinance. In the strictest sense, Anabaptists are those who not only re-baptise when they arrive at adult age persons who were baptised in infancy, but also as often as a person leaves one sect and joins another, or as often as he is excluded from the communion and again admitted into it; but the invalidity of infant baptism, in whatever way it is administered, is a tenet common to all sects of Anabaptists.

But some of those who assumed the name of Anabaptists professed principles of a different nature, and entertained peculiar notions of church establishment and its connection with human institutions. The plan of reformation proposed by Luther did not accord with their views. Their professed object was the foundation of a new church, which should be entirely of a spiritual and more perfect nature. The declaration of these doctrines soon increased the numbers and fanaticism of those who professed them; and the heads of the faction, Munzer, Stubner, and Stork, commenced their labours in Saxony in the year 1521. The arts of persuasion were at first resorted to, to disseminate their opinions, and to gain proselytes; but when the less powerful method of visions and revelations, which they pretended they received from heaven, failed, they had recourse to the more expeditious method of establishing their doctrines by force of arms. Munzer, and his associates, in 1525, saw themselves at the head of a numerous army, collected from all parts of Germany, and declared war against all human institutions, under the pretext that Christ was to take the reins of government into his own hands, and to reign over the nations. But this lawless rabble was soon routed and dispersed, and Munzer, their leader, was ignominiously put to death.

Many of his followers survived, and continued to propagate their opinions in different places on the continent. A party settled at Munster in Westphalia, in 1533, under the direction of John Matthias, a baker of Haerlem, and John Bockholdt, a journeyman taylor of Leyden. Aided by a powerful party from the country, they seized on the arsenal and senate-house in the night-time, and with drawn swords, and dreadful howlings, ran through the streets, crying out, "repent and be baptised, and depart ye ungodly." In the midst of this scene of confusion and disorder, the magistrates and the respectable part of the inhabitants fled, and left the fanatics in undisturbed possession of the city. Matthias framed a new constitution, ordered every man to bring forth his money and valuable effects, and deposited the wealth thus accumulated in a public treasury, for the common benefit of all. The members of the new commonwealth were commanded to eat at public tables, and the very dishes which were to be daily served up were specified; and at the same time he did not forget to provide prudent means for the defence of the city, which was dignified with the name of Mount Zion. The bishop of Munster advanced with an army to besiege the town; the fanatical leader sallied out, attacked his camp, and, after a severe conflict, returned to the city loaded with rich spoils. Elated by success, he appeared among his followers next day, and declared, that, like Gideon, he would, with a handful of men, smite the ungodly. Thirty persons were selected to accompany him in the mad enterprise of attacking the enemy, but not one escaped. After the death of Matthias, Bockholdt assumed the government, and declared himself the king of Zion; and under the pretext of Christian liberty, of being altogether unrestrained by the regulations of human institutions, he and his followers indulged themselves in all kinds of indecencies, and were guilty of every species of licentiousness. Among other practices, a plurality of wives was inculcated, and the leader himself, to exhibit a proper example, had fourteen wives. To suppress these disorders, the German princes furnished supplies of men and money to the bishop of Munster, who besieged the city, and reduced it to the utmost distress for want of provisions. The walls were scaled in the night by a party of the besiegers, who, unperceived by the enemy, opened the gates to their companions, and the fanatics being thus surprised, were, after an obstinate but ineffectual resistance, either put to the sword, or taken prisoners, after fifteen months possession of the city. Bockholdt himself was taken prisoner, and after being carried about from city to city, and exhibited as a spectacle, was cruelly tortured, and put to death at Munster.

Those who have adopted the doctrines of this sect in the present day not only renounce their licentious tenets and practices, but even reject the name of Anabaptist. In England they are denominated Baptists; in Holland Mennonites, from Menno their great reformer, and sometimes Waterlandians, from Waterland, a district of North Holland.

ANABASIS, a genus of plants belonging to the class Pentandria.

ANABOA, a small island near the coast of Loango, in Africa, which contains several fertile valleys, and produces large quantities of cotton, and abundance of all kinds of tropical fruits. N. Lat. 1°. E. Long. 9°.

ANACARDIUM, the cashew nut tree, a genus of plants belonging to the class Enneandria, one species of which, *anacardium occidentale*, is a native of the West Indies, and produces an agreeable acid fruit, which is sometimes employed as an ingredient in punch, and the cashew nut, which is frequently brought to this country, grows attached to the end of the fruit.

ANACHARSIS, a Scythian philosopher, who flourished 600 years before Christ, was the son of a person of rank in his nation, and a Grecian lady. By her he was instructed in the Greek language, and acquired a taste for Grecian literature. He was appointed by his fellow-citizens on an embassy to Athens; and having resided several years in that celebrated city, he travelled into different countries in quest of knowledge, and returned to his own for the purpose of instructing his countrymen in the laws and religion of the Greeks; but they were not prepared to receive the wisdom and learning of that polished people. While he was performing sacrifice to the goddess Cybele, he was slain by an arrow, which is said to have been discharged by the hand of his own brother, who was then king of Scythia, and was little disposed to encourage the innovations of Anacharsis. The history of Anacharsis has furnished the subject of a popular work, the Travels of Anacharsis, by Barthelemy, an eminent French writer.

ANACHORET, or ANCHORET, a hermit or solitary monk, who retires from human society, to avoid the temptations of the world, and to devote himself to meditation and prayer. Anachorets, among the Greeks, were chiefly monks who retired to caves or cells, with the permission of the abbot, and an allowance from the monastery; or such as were tired of the service of the establishment, purchased a spot of ground to which they might retreat and spend their days, returning to their monastery only on solemn occasions.

ANACHRONISM, from two Greek words, which signifies *above* and *time*, is an error in chronology, by which an event in history is placed at an earlier period than when it really happened; as when Virgil places Dido in Africa at the time of Æneas, which was 300 years before the actual period; but, in a more general signification, it is applied to any error in time, whether the event shall have happened at an earlier or later period than what is specified.

ANACLASTIC GLASSES, a kind of low flat bottles, resembling inverted funnels, and having the bottom, which is slightly convex, extremely thin. These glasses, from the flexibility of the bottom, emit a considerable noise, merely by the action of the breath. By breathing into a bottle of this description, the convex flexible bottom becomes concave, and, by sucking out the air it returns to the convex state, and from these motions of the flexible bottom the sound proceeds. By breathing strongly into these vessels, there is considerable risk of fracture; and even a gentle inspiration when the bottom is concave, or drawing out the air when it is convex, produces the same effect. These glasses are manufactured in Germany, where the property was first observed.

ANACREON, a celebrated lyric poet of Greece, who was born at Teos, a city of Ionia, and hence is frequently called the Teian bard, flourished about 530 years before Christ. His poetical talents procured for him an invitation to the court of Polycrates, the tyrant of Samos, and he lived to the age of 85, when, it is said, he was choaked with a grape stone, which stuck in his throat while he was regaling himself with new wine. A few fragments only of the works of Anacreon are extant, and both of the poet and his writings very opposite characters have been drawn; for while he is charged by some with licentiousness and sensuality, he is held up as a model of moral purity and virtue by others. His verses are described by one critic as sweeter than Indian sugar. His beauty and chief excellence consist in imitating nature, and in presenting to the mind only noble and natural images. The odes of Anacreon, says another, are flowers, beauties, and perpetual graces. Flowing always soft and easy, the joy and indolence of his mind are diffused through his verse, and his harp is tuned to the smooth and pleasant temper of his soul. The English translation by Mr Moore is perhaps not surpassed by the original.

ANACREONTIC verse, or poetry, is that which imitates the poetry of Anacreon, and is descriptive of amatory or bacchanalian subjects. This far-famed poet has found imitators in the Latin, English, and German languages. The most successful among the last are Lessing, Kleist, Goetz, and, above all, Gleim, who has been distinguished by the name of the German Anacreon. When the word is restricted to the structure of the verse, it refers to that which consists of three feet and a-half, and is usually composed of spondees and iambuses, and sometimes anapæsts, as the verse of Horace:

Lydia, dic per omnes.

ANADYR, a river of Siberia, which derives its origin from a lake, and, running to the south-east, falls into the sea of Anadyr, which is part of the Pacific ocean. This river forms a singular boundary between two very different countries. A region of absolute sterility lies on the north, while the country on the south side is covered with lofty forests or rich pastures.

ANAGALLIS, or Pimpernel, a genus of plants belonging to the class Pentandria, two beautiful species of which are natives of this country.

ANAGNOSTA, or *Anagnostes*, a kind of literary domestic in the families of persons of distinction among the Romans, whose business was to read to them at their leisure hours, and particularly during meals. The emperor Charlemagne, who greatly encouraged literature and learned men, established a similar practice, and the same custom was observed by the ancient monks and clergy.

ANAGRAM, from two Greek words, signifies the transposition of the letters of a word or sentence, so that a word or sentence of a different signification is formed, as when *angelus* is formed from the word *Galenus*; *Alcuinus*, which is the anagram of *Calvinus*, and assumed by Calvin in the title of his Institutions. An anagram is sometimes formed by dividing one word into several, as the three words *sus, tinea, mus*, which are names of animals formed from the verb *sustineamus*. As an example of an anagram formed of a sentence, the question put by Pilate to Jesus Christ, *quid est veritas?* has been transposed into an answer *est vir qui adest*; but the ingenuity of the learned is now rarely occupied in this trifling literary amusement, for which, even in the 17th century, a composer of anagrams was retained, with a pension, at the French court.

ANAGYRIS, stinking bean trefoil, a genus of plants belonging to the class Decandria.

ANALEMMA, a projection of the sphere on the plane of the meridian, orthographically made by straight lines and ellipses, the eye being supposed at an infinite distance in the east or west points of the horizon. The same word also denotes an instrument of brass or wood, on which this kind of projection is drawn, and it is employed to solve astronomical problems.

ANALOGY denotes a certain relation and agreement between two or more things, which, in other respects, are altogether different. A great deal of the reasoning of mankind depends on analogy; and when it appears that the things compared have a great resemblance, it is fair to conclude that they are subject to the same laws. Thus, in observing the appearances in the motions of the planets which belong to the solar system, and in discovering a resemblance between their motions and those of the earth, a strong degree of probability is obtained that these planets are the habitations of various orders of living beings.

But as reasoning from analogy affords only probable evidence, great caution is necessary to avoid error in employing forced resemblances and inaccurate comparisons. Comparative anatomy furnishes an excellent example of just analogy in examining the teeth of the huge animals whose bones were discovered in the western regions of America, and in concluding from the resemblance which is observed between them and those of a race of animals existing at the present day, and whose habits are well known, that the fossil teeth belonged to graminivorous animals; and an example of false analogy is derived from a comparison of the *stapelia*, a genus of plants which are natives of the arid deserts to the westward of the cape of Good Hope, and are remarkable for their succulency, with the camel, which is furnished with a peculiar bag or stomach for retaining a supply of water to support the animal in its fatiguing journies through the burning sands, and from this mistaken resemblance the stapelia has been, with little propriety, denominated the *camel of the desart*. But the structure, functions, and habits of the plant and animal present no precise similarity, and any conclusions drawn from the one and applied by analogy to the other must prove erroneous. Reasoning by analogy is extensively and successfully employed in Bishop Butler's celebrated work on the "Analogy of Religion, Natural and Revealed, to the Constitution and Course of Nature."

ANALYSIS, in its general acceptation, signifies the resolution of something compounded into its original and constituent parts. *Mathematical* analysis is the method of investigating a proposition to some known operation, or acknowledged principle. *Logical* analysis consists chiefly in combining our perceptions, arranging them into classes, and communicating our thoughts under appropriate forms of expression, and representing their several divisions, classes, and relations. *Chemical* analysis is the decomposition of a compound body, or the separation of its principles or constituent parts. The same word is employed to denote a syllabus, or table of the principal heads and subdivisions of a discourse arranged in the order and relative connexion in which the subject is treated.

ANAMABOA, a town in the kingdom of Fantin, on the Gold Coast of Africa. The town is one of the most opulent and populous upon the coast, and the neighbouring territory is distinguished by a rich and productive soil, which affords abundance of corn and fruits. Anamaboa was formerly considerable for the slave trade, for the protection of which the English erected a fort in the immediate vicinity of the town, and is still understood to be a place of some trade.

ANAMOOKA, or ROTTERDAM, an island forming one of the groupe called Friendly Islands, in the Pacific ocean, is about 18 leagues distant from Amsterdam island, to which it has a strong resemblance in appearance, soil, and productions. The chief harbour is on the south-west side; the greater part of the coast is precipitous towards the sea, and the reefs and sand-banks which surround the island render navigation dangerous.

ANAMORPHOSIS, a deformed or distorted representation of an object, which, being seen from a certain point, or reflected from a plane or curved mirror, assumes its natural or proper form, and appears in just proportion. See OPTICS.

ANANAS, a species of Bromelia, or the trivial name of the pine apple.

ANAPÆST, a foot in Latin poetry, which is composed of two short syllables and one long, as *scŏpŭlōs*. Anapæstic verses consist entirely of such feet.

ANARCHICAS, or Wolf-fish, a genus of apodal fishes. See ICHTHYOLOGY.

ANAS, a genus of birds belonging to the order of Anseres. See ORNITHOLOGY.

ANASTATICA, or Rose of Jericho, a genus of plants belonging to the Tetradynamia class.

ANATHEMA, from the Greek word which signifies to deposite or lay down, was an offering presented to some deity, according to the views of ancient mythology, and this offering was either laid on the floor of the temple dedicated to the god, or suspended from the wall. By offerings of this kind, the persons who had escaped from shipwreck or other imminent danger, or who had enjoyed a large share of prosperity, expressed their gratitude to the patron deity who presided over their good fortune. The usual offerings on such occasions were garlands, crowns, garments, or vessels of gold or silver. It was not unusual also for those who retired from any occupation, to dedicate the implements of their trade or profession to the presiding divinity.

ANATHEMA is also employed to denote the separation of a person from the society and privileges of the church to which he belongs, and is different from simple excommunication, because it is accompanied with curses and execrations. The anathema was practised in the primitive Christian church against great offenders. It was expressed according to the following form:—"Let no church of God be open to Andronicus, but let every sanctuary be shut against him. Private men and magistrates are admonished to receive him neither under their roof nor at their table; and priests more especially, that they neither converse with him living, nor attend his funeral when dead." Anathemas are pronounced against such as should attempt to corrupt the purity of doctrines; "If any one should be thus guilty, let him be *anathema*." Anathemas are either judiciary, when they are denounced by a council, the pope himself, or a bishop; or abjuratory, when a convert to be received into the bosom of the church renounces and anathematises the heresy which he abjures.

ANATOMY.

Introduction

THAT part of natural science which teaches the investigation of the structure and functions of animal bodies by dissection, is called *Anatomy*, from the Greek word which signifies to *cut up* or *dissect*. In treating this subject, it has been usual either to consider merely the *structure* of animal bodies, or to combine with that examination only those functions which are called *organic*, and which are explained chiefly by the structure of the organs by which they are performed. But, in the present treatise, we propose to take a general and connected view of the *whole animal economy*, in all the various classes of animated nature, from man to the lowest tribes of those beings which possess life and voluntary motion.

INTRODUCTION.

All the objects of nature, when compared together, are capable of being arranged under one or other of two great divisions. Some of them are composed of parts that are easily separated without destroying the nature and properties of the whole; they increase by the approximation or aggregation of their component particles, and possess no inherent power of resisting those changes that may be produced on them by external agents. Such are called *inorganic* bodies, or crude matter, and compose the numerous *mineral* substances which are dug from the bowels of the earth, or lie motionless upon its surface. Others again have their component parts arranged in *systems* or *organs*, which are generally different in different parts of the same body; they increase by *growth*, and nourishment, and they possess within themselves, to a certain degree, the power of resisting the effects of other bodies. These are called *organized* beings, and are said to be composed of *living matter*. Such are *plants* and *animals*.

General Anatomy may be said to include the consideration of the structure of both these divisions of organized beings; but as the anatomical examination of plants is generally treated of under *Botany*, we shall here confine our attention entirely to the *animal* kingdom.

Division.—Anatomy has been divided into *human* and *comparative*, the former being confined to *man*, the latter extending to the *inferior animals* compared with man or with each other. The present treatise is intended to be strictly comparative in the former sense, for though we shall take man as our model, and be more minute in our account of his structure and economy than in that of the brute creation, we shall be careful to notice all the more remarkable peculiarities which distinguish other animals from the human species.

Advantages of anatomy.—On the utility of anatomy and physiology, much might be advanced; and indeed there are few subjects more interesting, whether we consider them in themselves, or as forming a necessary and important introduction to other sciences, particularly natural history and medicine. In contemplating the works of nature, with the view either of gratifying a laudable curiosity, or of making ourselves acquainted with those objects that continually surround us, and either minister to our wants and comforts, or oppose and obstruct us in our pursuit of these comforts; or with the more sublime and elevated view of raising our minds and affections "from nature up to nature's God;" all are peculiarly interested in the study of the *animal* economy. The structure and functions of man, and of those animated beings that resemble him, are objects which demand the particular attention of those who are to devote themselves to the medical profession, as they constitute the very foundation of medical science. To the zoologist, who wishes not merely to study the habits and manners of animals, but to understand the nature and principles of modern classification, comparative anatomy is essential, as the characters of the classes, orders, and genera of animals, are drawn as much from their intimate structure as their external forms. Several artists, too, as the painter and the statuary, require a pretty correct knowledge of the forms and proportions of the animal body before they can faithfully represent them in a picture or a statue. The prominences of the bones, the rounding of muscles, in their ordinary state of quiescence, as well as when rendered more prominent by action, must all be accurately studied; and that artist who knows them best will most successfully copy nature, and of course please most in his profession.

Introduction

Before entering on a particular examination of the structure and economy of animals, it will be of great importance to take a general comparative view of the organic functions in the order in which we propose to consider them.

The organic functions of animals are, *Motion*, *Sensation*, *Digestion*, *Absorption*, *Circulation*, *Respiration*, *Secretion*, *Excretion*, *Integumation*, and *Reproduction*.

Voluntary motion.—All animals possess the faculty of voluntary motion, though this function, and the organs subservient to it, are extremely different in degree and complication in the several classes of animated nature. The more perfect animals have solid organs, called *bones* and *cartilages*, or gristles, connected together by *ligaments*, so as to form joints or *articulations*. These bones are set in motion by fleshy fibrous organs, called *muscles*, generally connected to the bones by *tendons* or sinews. Many classes and tribes of animals have however no bony system, though all must possess something analagous to muscles. That part of anatomy which describes the bones of an animal is called *osteology*; that which describes the ligaments is called *syndesmology*, and that which treats of the muscular system is denominated *myology*.

Sensation.—As a connecting link between voluntary motion and sensation, all animals must possess certain sentient organs, though, in all, these are not distinctly perceived. In what are called the more perfect animals, the sentient organs are very complicated, consisting of a pulpy mass within the head, called *brain,* and numerous filaments or cords connecting this with various parts of the body, and called *nerves.* These nerves in many cases form knots called *ganglions,* and sometimes they are connected with each other into a sort of net-work called *plexus.* A great proportion of the animal kingdom have nerves, without a brain, and in many even the nerves cannot be distinctly traced. That part of anatomy which treats of the brain and nerves, or *nervous system,* is denominated *Neurology.*

Digestion.—Animals are farther distinguished from plants by their mode of growth. They do not, like the latter, merely imbibe nourishment from the medium in which they live, but receive the means of support into a particular cavity, where it undergoes certain changes, which fit it for becoming part of the animal body. In this function, which is called *digestion,* animals also differ considerably from each other. In some the apparatus is still more complicated than in the two functions already noticed. In some the food is received into a mouth, chewed or *masticated* by teeth and gums, swallowed by a *gullet,* whence it is carried into a stomach, and, after remaining for a certain time, passes into a continuation of the same tube, called *intestines,* to undergo those changes which fit it for nutrition. Many animals have a mouth, but no teeth; some, as having no head, are destitute of both, though they possess both stomach and intestines; while others have only one short cavity, serving at once the purpose of mouth and intestinal canal.

Absorption.—After the food has undergone the necessary digestive process, the nutritious particles of it are taken up by particular tubes, thence called *absorbent,* and either carried directly to their place of destination, as in the more simple animals, or conveyed through a more or less complicated apparatus of tubes and bodies called *glands,* to a common reservoir, from which they are afterwards distributed to those organs of which they are to form a part. This function is called *absorption,* and the organs subservient to it the *absorbent system.*

Circulation.—All animals have the body composed partly of solids and partly of fluids. In a great proportion of them the fluids are in considerable quantity, and constitute what is called their *blood.* This blood is contained in innumerable canals or *vessels,* communicating with each other, and in most cases composing two sets or systems. In all the more perfect animals, the blood continually moves from the larger parts or *trunks* of one set of vessels, called *arteries,* to the extremities of their *branches,* whence it enters the branches of the second set of vessels, called *veins,* and proceeds through the trunks of these latter to a common reservoir or centre. This centre is a hollow fleshy cavity, more or less complex, called the *heart,* the use of which is to propel the blood into the arteries and receive it back from the veins; this function is called *circulation,* and the whole apparatus of heart, arteries, and veins is called the circulating or sanguiferous system. That part of anatomy which treats of this system is called *Angeiology.*

Respiration.—In all the animals with which we are acquainted, the continual or occasional presence of atmospheric air is necessary for the perfect performance of their several functions, though many of them do not carry on what can properly be called *respiration.* In the higher classes, however, there is a peculiar set of respiratory organs adapted to the medium in which they usually reside. Those which live entirely or chiefly in the air, respire by means of membranaceous spongy bags called *lungs,* which are alternately distended and contracted during *inspiration* and *expiration.* Again, those which live entirely in the water respire through vascular plates, called *gills.* Many of the less perfect animals also possess respiratory organs similar to gills, denominated *branchiæ.*

Secretion.—In all those animals which possess a true circulating system, and in those which have only vessels for containing the general fluids, certain parts are continually separated from the general mass of blood, to answer some important purpose in the animal economy. This function is called *secretion,* and the organs subservient to it *secretory* organs. On these we cannot at present dwell, but shall treat of them in their proper place.

Excretion, &c.—There is a function similar to secretion, by which the useless, noxious, or *excrementitious* parts of the food or fluids are thrown out of the body. This is called *excretion,* and its organs *excretory* organs. All animals have the faculty of reproducing or propagating their like. In most cases this is effected by peculiar organs; but in some, as in the lowest tribes of animated nature, the young are produced by shoots or offsets from the parent animal.

Those organs, which are contained within the principal cavities of the animal body, are technically called *viscera*; and that part of anatomy which treats of them is called *splanchnology.*

All the organs now enumerated are connected together, lined, or covered with extensive expansions, denominated *membranes*; and the whole body is covered and defended by *integuments.*

Diversity of structure.—On comparing the different tribes of animated nature with respect to their structure, we find that they may be conveniently distributed under two great groupes. Some of them have an internal skeleton, or assemblage of bones united together by moveable joints; and, in particular, they have a series of these articulated bones, extending from the head to the opposite extremity, called by anatomists the *vertebral column.* These are hence called vertebral animals, and include man, quadrupeds, cetaceous animals, birds, reptiles, serpents, and fishes. The other great subdivision of animals has no internal skeleton, and of course no proper vertebræ. These are, therefore, invertebral animals, and comprehend those classes which are called crustaceous animals, insects, mollusca, worms, and zoophytes.

The vertebral animals have all more or less of a brain within the cavity of the head. Some of them have a heart, with two independent fleshy cavities, called *ventricles,* for propelling the blood into the vessels that convey it through the body; and the blood contained in these vessels is said to be warm, because it considerably exceeds the medium temperature of the atmosphere. These are called warm-blooded animals, and they breathe by means of *lungs.* Some of them are *viviparous*, or bring forth living young, which they suckle by means of teats, as man, quadrupeds, and cetaceous animals; while others are *oviparous*, or produce eggs, which are afterwards hatched, and do not suckle their young, as birds. In the other subdivision of vertebral animals, we find a heart, either with a single fleshy cavity, or with two, which freely communicate with each other; and their blood is said to be cold, as its temperature is seldom much greater than that of the air or water which they inhabit. These are the *cold-blooded* animals. They are all essentially oviparous. Some of them have lungs and jointed members, as reptiles; others have lungs, but no jointed members, as serpents; and the rest breathe by means of *gills*, as fishes.

The invertebral animals have no brain. Some of them have an external articulated case, which cannot properly be called a skeleton, and jointed members; while others are destitute both of articulated case and jointed members. The first subdivision of invertebral animals comprehends the crustaceous animals and insects; the former having a circulating system, and generally a calcareous covering, and breathing by means of gills, called *branchiæ:* the latter without circulating system, having a horny external covering, and breathing by means of porous organs, called *tracheæ*. The second subdivision of invertebral animals comprehends those which have simple nerves, called *mollusca*; those which have knotted nerves, generally denominated worms; and those which have no perceptible nervous system, called *zoophytes*.

Living power.—The remarks now offered embrace a general view of the organic functions which distinguish organized beings from inorganic matter, and refer to the property of resisting the effects of external agents possessed by the former. We shall now consider the nature and effects of that cause which enables organized beings to resist those changes to which brute matter is continually exposed. We find that this power resides in organized beings only for a time; and that a period at length arrives, when they are as much exposed to the action of chemical powers as the minerals which form a part of the substance of the earth. When that period arrives, their organical functions have ceased to act, and the organized body has lost something by which these functions were supported. This something is distinguished by the name of *life*.

Life, then, is *that power by which organized beings are enabled to resist external agents, and to carry on their organical functions.* Of its essential nature we know nothing, as we see it only by its effects. The cause of life, whatever it may be, is called the *vital principle*, or the principle of vitality; and this principle exists in all organized beings, which are therefore called living beings. It does not, however, exist in an equal degree in all living beings, or reside in the same proportion in all parts of the body. Those animals which possess the fewest functions, as zoophytes, seem also to possess a lower degree of vitality; but it is more equally diffused throughout their substance. If a polype be cut in pieces, each piece lives and grows, and in time becomes a complete polype. The more perfect animals, who exercise all the organical functions which we have enumerated, also possess the highest degree of vitality, but possess it more completely in some particular organs, as the heart, the brain, or the stomach. The heart of a frog palpitates for some hours after it is removed from the body; and the head of a turtle or a snake has been known to bite for hours, or even days, after separation. In the higher classes, only the *cuticle*, or scarf-skin, the *hair*, and *nails*, or analogous parts, are entirely destitute of life.

All animals are not equally tenacious of life; and, in general, the more perfect the animal, that is, the greater the number and complication of its functions, the more easily is it deprived of life. A sudden violent blow on the temple or the stomach is often sufficient to kill a man; the insertion of a pointed instrument into the spinal marrow, instantly converts a living ox into a dead carcass: but an eel may be flead alive, and cut in several pieces, and still shew evident marks of vitality; a salamander may be deprived of its heart, and still swim about as usual; and a tortoise may have its brain scooped out from the cavity of the skull, and still walk about with apparent indifference.

The duration of life is extremely various, but generally keeps pace either with the complication of the functions, or the tenacity of the vital principle. There are insects which, in their perfect state, live but for a day; others of the same class enjoy existence for a summer, or a year or two;—while, in the higher classes, the existence of a few, as the raven and the elephant, is prolonged for nearly a century; and man, the lord of the creation, though generally restricted to threescore and ten, is sometimes found to linger out for more than a century and a half.

Chap. I. Of the Bones and Organs of Motion.

The bony system of animals cannot properly be said to constitute any part of their organs of motion, but rather furnishes the levers and *fulcra*, or props on which the moving organs act, while it gives strength and solidity to the whole animal machine. It is to the bones that the body owes its diversity of figure, and these solid parts form the cavities in which the more important organs are lodged, and by which they are defended.

Sect. I. *Of the Bones.*

Nature of bones.—In their substance the bones are the most solid parts of the body, being formed in a great measure of that peculiar earthy substance called *phosphate of lime*, cemented together by animal gelatinous matter. In a full grown body the bones are more or less of a white colour, especially on their outer surface, but in young animals they are bluish, and sometimes of a reddish colour. When cut or broken in a living animal, the inside exhibits the appearance of numerous red points. In general they are harder on the external surface than within, and this hardness increases with age.

Form.—The form of the bones differs considerably in various parts of the body. Sometimes they are long and nearly cylindrical, as those of the arm, thigh, and leg; sometimes they are flat, and of an oblong or rounded form, as the blade-bones; at others they are arched, so as to be convex on the one side and concave on the other, as the bones of the skull; and frequently they are very irregular in their form and structure. They are generally described as being composed of a body and *processes*, or protuberances, and these processes receive different names according to their form and relative position. The round protuberances at the extremities of the long bones are called *heads*, which are sometimes united to the body of the bone by a contracted part called *neck*, and, when formed so as to move like a hinge on other bones, *condyles*; when round and rough they are called *tuberosities;* when extending to meet another bone, so as to form an arch, *zygomatic;* and sometimes they are denominated *mastoid*, *styloid*, *pterygoid*, *coracoid*, &c. according as they are supposed to resemble a nipple, a pencil, or *stylus*, a wing, a bird's beak, &c. These processes, and in general the extremities or edges of a bone, and sometimes its superficial cavities, are covered with cartilage, which is often smoother, more elastic, and of a bluer colour than the bony substance.

Cavities.—The bones have also various cavities, hollows, or depressions. Some of them, as the long bones, have an internal tubular cavity, extending for a considerable length; others have large hollows, called *sinuses*, formed within their substance; some have external hollows, more or less deep, for receiving the heads or condyles of other bones; and in most bones there are furrows, canals, or holes, for the passage of blood-vessels or nerves. In general, the extremities and protuberant parts of bones are more loose and spongy, in their internal texture, than the body or middle of the bone; and sometimes the texture is so loose that numerous cells are formed communicating with each other.

Covering.—Bones are covered on their outside with a fibrous membrane, called *periosteum*, and their internal cavities and cells are lined with a similar but more delicate membrane, of a net-like texture. Within the interstices of this latter membrane there is lodged a thick oily matter called marrow.

Formation of bone.—In a *fœtus*, or young animal, before birth, the bones are in a soft or gristly state, and gradually acquire their proper consistence as the animal advances towards maturity, the gristly substance being removed and replaced by bony matter. This process is termed *ossification*, and takes place in a very gradual but uniform manner. A few white specks appear first in the middle of what is to form the body of the bone; these gradually increase till they form fibres, which either run in a radiating direction from a common centre, as in the flat bones, or extend in successive bony rings from the middle to the extremities, as in the cylindrical bones. In the *fœtus*, too, each bone is made up of several pieces, which are afterwards united; and commonly the process of ossification is going on at the same time in each of the component pieces.

Articulation.—The bones are connected or articulated together in several different modes, according as they are immoveable or moveable on each other. Sometimes the edge of one bone is intimately and closely united to that of another, so that their juncture is scarcely visible; sometimes the edges are indented into each other as if they were stitched together, forming what is called a *suture;* in a few instances, the edge of one bone lies over that of another, like a scale; and, in others, one bone is firmly fixed in the body of another, like a nail in a piece of wood. All these connexions are immoveable. Of the moveable articulations there are three principal kinds; 1st, where the extremity of one bone moves on that of another, like a hinge, as in the elbow and knee; 2d, where the head of one bone moves in almost all directions within a cavity or depression of another, as in the shoulder and hip-joints; and, 3d, where one bone moves upon another by a sort of rotatory motion, as the hand upon the elbow, or the head upon the neck. Anatomists have enumerated many more varieties of articulation, and have given to each appropriate names.

Ligaments.—The articulations of the bones are protected by strong fibrous membranes, extending from one bone to another. These are the *ligaments*, and have received different names according to their situation and direction. Thus, there are *central* ligaments, extending from the head of a bone to the cavity in which it moves; *capsular* ligaments, forming a bag, more or less loose, round the head of a bone and the brim of its receiving cavity; *lateral*, *crucial* ligaments, &c. The extremities of these ligaments are sometimes attached immediately to the bone or cartilage; but in general they are united to the bones through the medium of the *periosteum*.

Mucous follicles.—In the moveable articulations there are several circumstances to be considered, which assist the motions of one bone upon the other. In all the principal joints there are little bags, or hollow membranes, containing a glairy mucilaginous fluid, so situated that the pressure produced by the motion of the joint squeezes out a portion of the fluid, so as to lubricate the contiguous surfaces of the articulated bones, as oil assists the motions of machinery by diminishing the friction of one part upon another. The fluid thus prepared within the cavities of joints is called *synovia*, and the membranes which contain it are termed synovial bags, or *mucous follicles*. The fluid itself, in colour and consistence, resembles the raw white of egg.

Moveable cartilages.—Besides this synovial apparatus, there are, in some of the joints, moveable cartilages between the articulated surfaces, which being compressible and elastic, tend to diminish both the pressure on the lower bone and the friction of the bones upon each other. In other joints, as those of the back, there is sometimes an elastic substance, resembling cartilage, but immoveable, interposed between the bones; and sometimes, as in fishes, each of the contiguous bones forms the half of a double close cavity, filled with a mucilaginous fluid, resembling the synovial apparatus.

General remarks.—The greater blueness or redness of the bones in young animals depends on their greater vascularity, or the greater proportional quantity of blood that circulates through them. As the animal advances in age, and especially after he has acquired his full growth, many of the vessels in the bones become obstructed or obliterated; hence a less proportional quantity of blood is transmitted through them, and they become of a whiter colour, and harder consistence.

The cavities, and internal spongy texture of bones, make them both lighter and more capable of resisting external force, while they serve to contain the marrow, which helps to keep the bones sufficiently moist and flexible. The larger extremities and processes of bones serve for the attachment of ligaments and muscles, while they facilitate the motions of the animal.

The periosteum, besides other uses to which we cannot at present properly refer, assists in checking the overgrowth of the bones, strengthens the connection of the bones with their ligaments and cartilages, and helps to protect them from external injuries.

The division of each bone into several parts, in the young animal, has several important uses. It enables the animal to occupy a smaller space before birth, by increasing its flexibility; it materially assists the easy exclusion of the fœtus at birth, and it accelerates the formation of bone by increasing the number of ossifying points.

Diversity in different animals.—The differences in the general structure of the bony system, in the various classes of animals, are not very considerable. The bones of quadrupeds resemble those of man, except that in the larger species they are proportionally stronger, their texture coarser, and their prominences more distinctly marked. The whale tribe of animals have the fibrous texture of their bones looser than that of man and most quadrupeds, and the internal cavities more conspicuous, and filled with a thinner and more oily fluid. In birds the bones have also very large internal cavities, but they are destitute of marrow, and are filled only with air, a structure which contributes materially to increase the buoyancy of those animals in the atmosphere. In one order of fishes the skeleton is entirely cartilaginous, and in the rest the proportion of gelatinous, compared with that of earthy matter, is very great. In reptiles and serpents the texture of the bones is very uniform, and, in some cases, their solidity is very considerable. In these animals, as well as in fishes, the bones are much more simple in their form, and have fewer prominences than those of the superior animals.

The hard parts of the invertebral animals, though sometimes called their external skeleton, have little analogy with the bones of vertebral animals, except in similarity of substance. They are more properly integuments than skeletons, and, with the horns, hoofs, and nails, will fall to be considered under the head of INTEGUMATION. We now proceed to describe the several parts of the skeleton, which is usually divided into the head, trunk, and extremities.

Bones of the Head.—The head is composed of numerous pieces, connected together, with only one exception, by immoveable articulations. The component bones are conveniently arranged in two groupes, those of the skull and those of the face.

Bones of the skull.—In man, the skull, or brain-case, called by anatomists the *cranium*, is composed of eight bones; one forming the forehead, and composing the upper part of the orbits or sockets of the eyes, termed the *frontal bone;* a second forming the back part of the head, called *occipital bone;* two lying between these at the top of the head, the *parietal bones;* one placed on each side below the parietal, forming the temples, and called *temporal bones;* a seventh, connected with the frontal bone, above the root of the nose, called *ethmoidal;* and an eighth, wedged in the lower part or *base* of the skull, called *sphenoidal bone.*

The *frontal bone* extends in front between the two prominent points that may be felt on the temporal sides of the orbits, and, forming two arches below the eyebrows, runs down a little in the middle to meet the nose. From the orbitar processes it runs backward about an inch on each side forming part of the temples, and then takes a semicircular sweep nearly over the top of the head.

The whole top of the head, and part of its sides, backward from the frontal bone, are formed by the *parietal bones,* which are each of an irregular four-sided figure, united to each other in the middle of the top of the head, by a straight suture called the sagittal suture, and to the convex edge of the frontal bone by two concave edges, forming the coronal suture.

The *occipital bone* forms that remarkable protuberance or ridge at the back of the head, is of an oblong, irregular, four-sided figure, with very obscure angles, and is united to the parietal bones, and to those that are immediately to be described, by a suture, which, from its fancied resemblance to a Greek letter, has been called lambdoidal. This bone has several remarkable ridges and depressions on its lower surface, and a very large oval hole near its anterior extremity, and towards the fore part of this hole there are two remarkable protuberances or condyles.

The *temporal* bones form the rest of the sides of the head, occupying the region of the ears, and may be readily distinguished in the living body by a remarkable protuberance behind the ear at their back part, and by an arch extending from the fore part of the ear towards the cheek. Each is composed of two parts, one called the *squamous portion,* thin and broad, overlapping the parietal bone, and an irregular, very hard, and thick part, called the *petrous portion,* extending inwards, and containing the organ of hearing, with a remarkable external orifice, by which it communicates with the air. The projection behind the ear is called the *mastoid,* and the arched portion before the ear the *zygomatic process.* Besides these there is a remarkable long and pointed process, not perceptible externally, called the *styloid,* which runs forward and inward, and serves, like the two former, for the attachment of muscles.

The *ethmoidal bone* is the smallest of those that belong to the skull. No part of it is perceptible externally, but it occupies the upper part of the nose and of the space between the eyes. It is composed chiefly of a spongy body, full of cells, that are lined with a membrane, having an upper plate perforated with numerous holes, from the middle of which rises a thick, flat process, upwards within the skull, while from its lower surface there descends a similar plate of larger dimensions, forming part of the partition that separates the nostrils from each other. The sides of this bone next the orbits are flat and smooth.

The *sphenoidal bone* is exceedingly irregular, and its figure is not easily understood without actual observation. The body of it is wedged in the base of the skull, and from it extends a broad process on each side to meet the temporal parts of the frontal bone, while two other long processess, with deep furrows on their back part, pass downwards at the back of the mouth, and between these latter is a sharp ridge. This bone is pierced with numerous holes, and within the substance of its body are two of those large cavities called sinuses.

Interior of the skull.—In the above descriptions we have purposely avoided the inner surface of the bones, which we shall now notice in giving a general view of the interior of the skull. The upper part and sides of this cavity are nearly smooth, except a few superficial depressions and furrows, marking the protuberances of the brain and the course of blood-vessels; but its lower surface, or *base*, is rendered very unequal by numerous hollows and processes, especially at its middle, lateral, and back parts. Nearly in the middle of the base is fixed the body of the sphenoidal bone, with a considerable depression, surrounded by three remarkable processes. On each side of these there are two deep hollows, formed by the broad processes of the same bone, and immediately behind its middle is a considerable declivity leading to the large hole in the occipital bone. On each side of this lie the petrous portions of the temporal bones, with numerous furrows, depressions, and holes in their neighbourhood. The back part of the occipital bone is marked by two considerable prominent ridges, crossing each other in the middle, and forming four hollows, in which are lodged parts of the brain. From the upper internal process of the ethmoidal bone, there is either a ridge or furrow extending along the middle of the upper part of the skull, backwards and downwards, till it meets the crucial ridge of the occipital bone, the whole serving as attachment to a strong membrane that lines the skull and envelopes the brain.

Bones of the face.—The face is composed of fourteen bones, besides the teeth; these are generally divided into the upper jaw, containing thirteen bones, all articulated immoveably together, and the lower jaw moveable on the former. The thirteen bones composing the upper jaw are:

Two nasal bones of an oblong irregularly four-sided figure, convex on the outside and concave within, forming the upper part or bridge of the nose;

Two ungual bones of a rounded form and very thin substance, situated on the internal or nasal sides of the orbits,

Two malar or cheek bones, of an irregular, foursided form, with four remarkable angles, and a concave arch above, forming the external or temporal, and part of the lower edge of the orbits, their body constituting the well known bony projection of the cheeks;

Two superior maxillary bones, forming the principal part of the upper part of the upper jaws, the sides and floor of the nostrils, the sockets of the upper teeth, and the greatest part of the palate or roof of the mouth, and each having within its substance a large cavity or sinus communicating with the nostrils;

Two palate bones, making up the back part of the palate, with two concave arches towards the throat, two long irregular perpendicular processes extending upwards towards the orbits, of the floor of which they form a part, and a middle ridge between these, where the two are united to each other;

Two inferior spongy bones withinside the nostrils, where they are connected with the ethmoidal, superior maxillary, palate, and ungual bones; and the

Vomer, extending between the middle ridge of the sphenoidal and the junction of the palate bones within the nose like a plate, so as to form the greater part of the bony partition between the nostrils.

The lower jaw bone resembles the capital letter U, with its extremities turned at an obtuse angle upwards and backwards; it is narrowest at the chin, and its branches gradually diverge to the angle, where its sides rise into two remarkable processes, one backward, terminating in a rounded flattened head, articulating with the temporal bone before the zygomatic process, and the other pointed with a deep furrow within, for the attachment of one of the strong muscles by which the lower jaw is raised and pressed against the upper. The substance of the body of this bone is hollowed into two canals, communicating by holes with the back of the mouth, and externally with the sides of the chin. In its upper edge are formed the sockets of the lower teeth.

Facial angle.—In comparing the skulls of different animals, it is of consequence to attend to what is called the *facial angle*, which is formed by two imaginary lines supposed to be drawn, the one horizontally, in a direction parallel to the floor of the nostrils, and the other upwards, touching the inferior margin of the upper sockets of the teeth and the most projecting fore-part of the skull. This angle is greatest in the human subject, especially in a well formed European, and in those quadrupeds which most nearly resemble man, as apes; becoming gradually more acute as we proceed downward in the scale of animals to *cetacea*, *birds*, *reptiles*, *and fishes*.

Varieties of form, &c.—The skulls of different animals vary considerably in their general appearance, composition, and proportion, between the cranium and the face. In a few instances, as in the ourang-outang and the elephant, the vertical diameter of the head is at least equal to its horizontal diameter; but in most cases the reverse is found to prevail. The head is roundest in quadrupeds, birds, and most reptiles and longest in some of the *cetacea*, most fishes, and in crocodiles among reptiles.

The proportion between the cranium and face is extremely various, though it generally observes a pretty regular gradation as we descend from man to fishes. In the human subject the cranium is about four times as large as the face; in apes and monkeys more than twice as large; in baboons, and most beasts of prey, the proportion is nearly equal. In the ruminating quadrupeds, again, the face is double the cranium; in the hippopotamus, or river horse, the latter is three times as large as the former; and in the horse it is four times as large. In some of the cetaceous animals the outline of the cranium is very large, in proportion to that of the face. In birds, again, in reptiles, and in fishes, the area of the face is many times greater than that of the cranium.

With respect to the number of bones composing the head, this does not differ so much as might have been expected. The cranium of quadrupeds is generally composed of the same number of pieces as that of man, though, in some instances, the frontal, or sphenoidal bones are divided into two, and in others the parietal bones are closely cemented together. In the elephant, all the principal bones of the cranium are consolidated into one uniform long shell. In the cetacea, the parietal, occipital, and temporal bones are united.

There is a remarkable difference between man and quadrupeds, in the situation of the great occipital hole. In man this hole is almost in the middle of the base of the skull, and in nearly a horizontal position. In apes, especially the ourang-outang, which sometimes imitates man in his erect posture, this hole is situated a little farther back; while in the lower qnadrupeds it is still nearer the back of the head, and is so placed as to form a considerable angle with the horizon.

The trunk.—The bones of the trunk are arranged by anatomists under three divisions; the *spine*, or vertebral column, the *pelvis* or basin, and the *thorax* or chest; and this division, with the exception of the pelvis, holds in all the classes of vertebral animals.

Vertebræ.—The spine consists of numerous pieces, called *vertebræ*, which are divided into those of the neck, back, and loins. Each vertebra, except the one next the head, which is little more than a bony ring, with two depressions for receiving the condyles of the occipital bone, is divided into a body, a process extending backwards, and generally more or less pointed, called *spinous* process; one extending on each side outwards, called *transverse* processes; and two on each side, one above and one below, with articulating surfaces, having an oblique direction, and therefore called *oblique* processes. The body of the vertebra is more or less of a rounded form, with a smooth, flat, or rather concave surface, next the spinous process, where there is a considerable hole, and having two flattish surfaces for its articulation to the contiguous vertebræ.

The vertebræ of the neck, which, in the human subject, are seven in number, are distinguished from the rest by having a circular hole through each of their transverse processes. Their bodies are also smaller, and the great hole proportionally larger. The second of them has a process standing perpendicularly from the body, shaped somewhat like a blunt tooth, and resting against the inner fore-part of the vertebra above, which is articulated with the head, and turns round to a certain extent upon the second vertebra. The first cervical vertebra is called *atlas*, as supporting the head.

The vertebræ of the back differ from the rest in having their bodies very convex, the spinous processes long, pointed, and sloping downwards, and lateral depressions on each side for the articulation of the ribs. In man, they are twelve in number.

The vertebræ of the loins are distinguished by the spinous processes, which are strong, blunt, and horizontal, and by the want of lateral articulating surfaces. Their number in man is five.

All these vertebræ are united to each other in two ways. Between their bodies there is interposed a ligamento-cartilaginous substance, which, from its elasticity, enables the bones to move freely on each other, and by their oblique processes they are so articulated, and, as it were, wedged among each other, while their connexion is strengthened by numerous ligaments and muscles, as not easily to suffer dislocation. When united, the large holes between the bodies and spinous processes form a long continuous canal, which, in the recent body, is lined with a strong membrane, and contains that part of the nervous system commonly called the spinal marrow. Besides the lateral holes in the *cervical* vertebræ, through which important blood-vessels pass to the inside of the head, there are numerous orifices between the vertebræ for the passage of blood-vessels and nerves. The vertebral column does not form one straight line, but is variously bent in different parts. That part of the neck next the head retires a little backwards, while the rest of the neck advances forwards. The dorsal vertebræ form a curve, with its convexity next the back, and in the lumbar vertebræ the convexity is carried forwards. These various inflections answer several good purposes. Besides assisting in enlarging the cavities on the one hand, and supporting their contents on the other, they have considerable effect in balancing the several parts of the body, and regulating the centre of gravity.

Varieties.—The comparative differences in the vertebral column respect the number of pieces of which it is composed, and the greater or less complication of their structure. It is remarkable that almost all quadrupeds agree with man in having seven cervical vertebræ. The long-necked giraffe and camel have no more than the mole or the mouse. One exception only is known, the three-toed sloth, which is said to have nine cervical vertebræ. The number of *dorsal* vertebræ, again, differs in the various tribes, according to the number of ribs. Some of the apes and lemurs have fourteen, one species of ant-eater sixteen, the horse eighteen, the elephant nineteen, and the two-toed sloth twenty-three. In the cetaceous animals the number of cervical vertebræ may be considered as seven, though many of them are so cemented or united together as to form but one piece.

Birds differ from other vertebral animals in the number and composition of the vertebræ. In general they have more cervical vertebræ than other animals, the number varying from ten to twenty-three, and they are articulated by cylindrical eminences, so as to admit of free and extensive motion. The dorsal vertebræ, which vary in number from seven to eleven, are so cemented together as to be immoveable, and the rest of the spine forms another consolidated immoveable piece of bone.

In some reptiles, as turtles and tortoises, the vertebræ of the back are cemented together, and united to the upper shell; but in the other orders they are distinct. In serpents the number of vertebræ is very considerable.

In some fishes the number of pieces in the vertebral column is very great. Thus, for instance, the eel has more than a hundred vertebræ, and some sharks have above two hundred. In both these last classes the structure of the vertebræ is very simple, and their processes either very few, or extremely minute.

Pelvis.—The pelvis is situated at the lower extremity of the spine, and is composed of four principal bones, two forming a continuation of the vertebral column, called *sacrum* and *coccyx*, and one on each side, large and irregular, which has no proper name for the whole, though its several parts have been distinguished by particular appellations.

The sacrum in man is a large triangular bone, broadest at its upper part, where it is firmly united to the last vertebræ of the loins, convex behind and bending forward below, so as to form a concavity on its anterior surface. It bears the marks of having, in the fœtal state, consisted of five separate bones, now cemented together. At its upper, or large extremity, is the termination of the vertebral canal, and through its substance are formed four pairs of holes, for the passage of nerves and blood-vessels. On its back part are spinous processes.

The coccyx, or rump-bone, is small and triangular, and is articulated with the sacrum, which it resembles in its general structure and original conformation.

The side bones of the pelvis are each composed of three parts, one broad and flat, called *ilium*, or haunch-bone, convex externally, concave within, with a thick rough margin, and ending below in a hollow that forms part of a considerable cavity for lodging the head of the thigh bone; a second, called *ischium*, or hip-bone, forming the lowest part of the pelvis, of an irregular arched form, convex on its lower edge, and rising upwards to form another part of the great cavity; and a third stretching from the lower part of the *ilium* in front. and, meeting its fellow on the opposite side, so as to form a strong bony arch in front of the pelvis, called *pubes*, or share-bone. Where this last joins the ilium it is very thick, and helps to form the large cavity, or *acetabulum*, for the articulation of the thigh-bone. Between the share-bone and the ischium, on each side, there is formed a large hole called *thyroid*, which, in the recent subject, is nearly closed by a strong ligamentous membrane. The whole pelvis taken together forms a large opening, or cavity.

The comparative anatomy of the pelvis shews us that in no animal, except man, has it that hollow basin-like appearance. Its parts are proportionally smaller and more elongated in quadrupeds than in man, and some of those animals have the pelvis open in front. Cetaceous animals have no pelvis, but only a pair of small bones, resembling the pubes, next the tail. The coccyx is much longer in most quadrupeds than in man, forming, in fact, the bony part of the tail.

The pelvis of birds is most perfect in the ostrich, as in most of them the two side bones are at a considerable distance from each other. In these animals there is a coccyx, composed of from seven to nine pieces, to support the tail.

The pelvis of most reptiles is very small, and generally very imperfect, serving, in most instances, merely for the articulation of the hind legs. Fishes have no pelvis.

Bones of the chest.—The *thorax*, or chest, in man is composed of the twelve dorsal vertebræ already described, twelve ribs on each side, and the *sternum*, or breast bone.

The ribs are not all of equal size, the middle ones being the longest and roundest. They are all more or less arched, so as to form a considerable convexity externally, and a corresponding concavity within. They are flattened on their convex surface, especially towards the breast-bone, and the upper edge is rounder than the lower, in which latter there is a groove internally for lodging nerves and blood-vessels. Seven of these ribs are called true, and are articulated with the breast-bone, through the medium of long flat cartilages, whose length increases as the ribs descend; and the other five are termed false ribs, because the cartilages attached to them do not reach the breast bone. All the ribs are fixed each between two vertebræ, by an articulating head, and a flattened tubercle beyond the head, admitting of considerable motion upwards and downwards, and thus enlarging or contracting the cavity of the chest.

The sternum, or breast-bone, of the human subject, is generally composed of three parts; one next the neck, nearly resembling a heart, with the upper part very thick and notched in the middle; a second, long, thin, and narrow, compared with the former; and a third, smaller than the other two, generally more or less pointed at its extremity, and somewhat cartilaginous, hence called the *ensiform cartilage*. Along each side of the sternum are seven holes for the insertion of the true ribs, and on each side of the heart-shaped portion there is a cavity for the articulation of the collar-bones.

The thorax of quadrupeds is generally longer, narrower from side to side, and deeper from back to breast, than in man; the sternum is longer and narrower, and composed of more pieces; and the ribs are straighter and generally more numerous, following the proportion of the dorsal vertebræ. Among these animals, however, bats and armadillos have only eleven pairs of ribs.

The thorax of birds has several peculiarities. The ribs are few in number, perhaps never exceeding ten pairs; and the sternum, besides being broader and thinner, has a remarkable broad, thin, and sharp process, extending perpendicularly from its middle, thus allowing large and deep spaces for the attachment of those strong muscles which move the wings.

Some reptiles have a very large and extensive sternum, as turtles and tortoises, when the office of that bone is supplied by the lower shell or breastplate, and the crocodile, which, besides the ordinary sternum, has an additional bony plate, extending from the thorax to the pelvis. Some of them, as the salamander, have ribs but no sternum, while others, as the frog, have a sternum but no ribs. In many, as the lizards and chameleons, the ribs are very numerous. This is also the case with serpents, which have a prodigous number of ribs, but no sternum. In fishes the structure of the thorax is similar to that of serpents, except that in some the ribs are not connected with the vertebræ, and in the cartilaginous fishes there are no proper ribs at all.

For the sake of general application in comparative anatomy, we shall, with Dr Barclay, divide the extremities into *atlantal* and *sacral*, the former being those next the head, the latter those at the opposite end of the body.

The atlantal extremities in man consist of the *scapula*, or blade-bone; the *clavicle*, or collar-bone; the *humerus*, or shoulder-bone; the *radius* and *ulna*, or bones of the fore-arm; eight bones of the carpus or wrist; five *metacarpal* bones in the palm of the hand; two *phalanxes*, or joints of the thumb, and three of each of the fingers.

The blade-bone, is that broad triangular bone which is situated on the back, covering the upper ribs, being broadest at its upper or atlantal edge, and becoming gradually narrower towards its lower or sacral points; its longest side next the vertebræ is called the base. On the side next the ribs it is concave, and convex on the other side; and across this convex part. near the top, extends a perpendicular process, called the spine, which separates the convex part of the bone into two unequal portions. The spine terminates in a broad flat process called *acromion*, and near this there proceeds from the body of the bone a crooked pointed process, called coracoid. Between these, and a little lower, the bone is very thick, and forms a broad superficial cavity for the articulation of the shoulder-bone.

The collar-bone is long and round, and has nearly the form of the long italic letter *ſ*. It extends between the acromion process of the blade-bone, to which it is united by a broad flat extremity, and the heart-shaped part of the breast-bone, where it retains its cylindrical form. The chief use of this bone is to keep the blade-bone and arm in a proper position, and regulate their motions.

The humerus is long, cylindrical, a little twisted, and, like all the other long bones, smallest in the middle. Next the scapula, it terminates in a large round smooth head, situated a little obliquely with respect to the body of the bone, and surrounded by a rough furrow, and on the outside, near the head, is a considerable tubercle; at the other extremity, where the bone becomes broader, there are several processes, particularly two condyles, and a smooth part between them, which, in the motions of the elbow, performs the office of a pully. From the upper and fore part of the bone, near the large tubercle, there is formed a remarkable groove for lodging the tendon of one of the large muscles of the arm.

Of the two bones of the fore-arm the *ulna* is the largest at the extremity next the *humerus*, where it forms the elbow, by a process projecting backwards, and a hollow for receiving the pulley of the *humerus*. Hence it passes in a direction a little curved, tapering towards the wrist, where it terminates, on the side next the little finger, in a roundish head and a small projecting point.

The radius is smallest next the humerus, with which it is articulated by a round head, and with the side of the ulna by a lateral tubercle; hence it passes to the wrist, growing a little larger as it proceeds, and is articulated by a considerably irregular surface to the bones on the side of the hand next the thumb. Between the radius and ulna passes a strong ligament called *interosseous*, which strengthens the connection of the bones, regulates their motions, and assists in giving attachment to muscles.

The bones of the carpus, or wrist, are eight in number, and are placed in two rows; three of them, viz. the *scaphoid, lunar*, and *cuneiform*, being articulated with the radius and ulna, and five others, called *pisiform, trapezium, trapezoid*, the *large bone*, and the *unciform*, or hook-like bone, connected on one side with the three bones just mentioned, and on the other with the metacarpal bones.

The metacarpal bones constitute the frame-work of the palm of the hand. They are long, terminate at each extremity in a head, are flattened next the inside of the palm, and rounded next the back of the hand. One belonging to the thumb, has a freer articulation than the rest, and is therefore moveable in more directions.

The phalanxes, or bones of the fingers, resemble the metacarpal bones, except that they are shorter and more cylindrical. Those forming the tips of the fingers and thumb are the shortest and flattest, and have a rough surface near their extremities. The articulation of all these bones forms a simple superficial hinge, except where the bones of the fingers join the metacarpal bones, where the articulation is more free and the motion less confined.

Almost all the vertebral animals, except serpents, possess atlantal extremities. In quadrupeds and reptiles they constitute the fore legs, except that in bats and flying squirrels, among the former, and in the flying dragons of the latter class, they perform the office rather of wings than legs; in cetaceous animals they form the swimming paws, or, as they are improperly termed, the *pectoral fins;* in birds, they are the wings; and in fishes they support the real pectoral fins.

All quadrupeds, cetaceous animals, birds, and most reptiles, have a *scapula;* and in fishes there is a bone supporting the bones of the pectoral fin, which resembles a scapula in office, if not in figure.

A considerable number of quadrupeds have no clavicle, though it is by no means confined to apes, lemurs, and bats, or the order denominated by Linné *primates*. It is found in all those quadrupeds that make much use of their fore-legs; either for holding objects, as the squirrel and beaver; for climbing, as the sloth; for digging and raking the ground, as the mole, the ant-eater, and the hedgehog. Some other quadrupeds, as the *feræ* and some *glires*, have a small bone analogous to a clavicle, but not immediately articulated with the other bones. Cetaceous animals have no clavicle.

There is a peculiarity of structure in birds which deserves particular attention. The bone in poultry, which, in the vulgar language of the table, is called *hug-me-close*, really consists of two bones, the scapula, which lies horizontally and nearly parallel to the vertebræ, and is flat, and more or less broad, and the clavicle, which is cylindrical, and passes down at a considerable angle with the scapula to be articulated with the breast-bone. Besides these, there is a fork-like bone, commonly called the *merry-*

thought, having its angular point articulated with the most prominent part of the keel of the breast-bone, and the ends of its two branches join to the clavicle and scapula where these are united. By this mechanism, the wings are kept from approaching too near each other in the rapid motions of flying, while the whole articulation of the atlantal extremities is strengthened.

Many reptiles have a clavicle, which, in tortoises, is articulated with the humerus. No clavicle is found in fishes.

The humerus forms an essential part of the atlantal extremity in all the vertebral animals that have articulated members; but it is generally shorter, proportionally stronger, and more crooked than in man.

The radius and ulna are likewise very generally found in all these animals, though the former is wanting in the bat; and, in some cases, the two bones are closely united. In some reptiles, too, they form but a single bone, divided at each extremity into two conical pieces. They are not found in fishes.

Carpal and metacarpal bones are found in quadrupeds, cetaceous animals, birds, and reptiles, but vary considerably in their structure and proportion. In most quadrupeds the metacarpal bones are extremely long, forming what is called the leg. In cetaceous animals, again, these bones are short and thick. In birds there are two carpal and two metacarpal bones, of which the latter are consolidated together.

Several animals, both quadrupeds and reptiles, and some cetacea, resemble man very nearly in the structure of the fore-paw. This is particularly the case with the primates in the first class, and the porpoise in the last. In many quadrupeds, however, the number of toes is small, often two, and in some instances only one; and very few have what may be properly termed a thumb.

The sacral extremity in man is composed of the thigh-bone, the *patella* or knee-pan, two bones of the leg called *tibia* and *fibula*, seven bones of the *tarsus* or instep, five of the metatarsus, and fourteen of the toes.

The thigh-bone is the longest and strongest of the human body. It is articulated with the pelvis by a large spherical head set to the body of the bone by a long cylindrical neck, at the base of which there are two protuberances called the greater and less *trochanters*. The bone becomes broader and flatter as it passes to the knee, where it terminates in two very prominent condyles and a middle pulley.

The patella, rotula, or knee-pan, is of a rounded triangular form, narrowest next the leg, convex externally, and concave and very smooth internally, where it covers the knee. It is not firmly connected with the thigh-bone, but is loosely articulated, through the medium of strong tendons and a ligament.

The tibia forms the principal bone of the leg. It is not cylindrical, having a sharp ridge in front, constituting what is called the shin. It is largest at the end which joins the thigh-bone, where there are two superficial cavities divided by a double prominent ridge for receiving the condyles of that bone. It again grows large at the instep, where it terminates in two protuberances, of which the larger forms the inner ancle.

The fibula is a long slender bone, of nearly equal size throughout its whole extent, except that its two extremities are a little enlarged. It passes down on the outside of the *tibia*, has a small head, with a superficial cavity on one side by which it is connected with the upper side of the tibia, and terminates below in an oblong flattened protuberance that forms the outer ancle.

The knee-joint, formed by the thigh-bone, tibia and patella, is a very curious piece of mechanism. The condyles of the thigh-bone do not rest immediately on the corresponding hollows of the tibia, but there is interposed between them on each side a flat cartilaginous substance of a semilunar form, and thickest at the edge, by which the pressure and friction of the one bone against the other are diminished. The articulation is greatly strengthened by strong lateral ligaments, and crucial ligaments behind; while the tendinous and ligamentous expansion attached to the patella gives additional strength to the fore-part of the joint, and the whole is secured by a firm and complicated capsular ligament.

The tarsus, or instep, is formed of the *heel-bone* projecting behind, the *astragalus*, supported on the heel-bone, and having a smooth round process for the articulation of the tibia, the *navicular* bone, joining the fore part of the astragalus on the inside next the great toe, the *cuboid bone*, connected on the other side with the fore part of the heel-bone, and three *cuneiform bones*, that form a separate row, for the articulation of the metatarsal bones.

Of the metatarsal bones, that which supports the great toe is the thickest and strongest. In general they resemble the bones of the metacarpus, except that they are proportionally larger, flatter on the sides, and the round heads by which they are articulated with the bones of the toes are smaller.

The phalanxes of the toes very nearly resemble those of the fingers, and are articulated in a similar manner.

The form of the human foot is admirably adapted both to support the great weight which it is required to sustain, and to facilitate the motions of walking and running, without allowing these motions to be so free and lax as to encounter the risk of frequent dislocation. The bones of the *tarsus* and *metatarsus* are so connected together as to form a very secure arch, the highest part of which is the astragalus, which forms a sort of keystone to the whole fabric, while the foot rests chiefly on the projecting part of the heel-bone and the distant extremities of the metatarsal bones, as on the buttresses of the main arch. The bones are so firmly connected together by articulating surfaces and surrounding ligaments as not easily to be displaced, while they allow such a degree of motion as to prevent too great a shock of the body in the various actions in which the feet are chiefly employed.

All quadrupeds have the sacral extremities; for though some of these animals, as seals and walrusses, appear to have no hind legs, they have bones connected with the pelvis perfectly analogous to the thigh-bone, &c. though they approach too near each other, and are thrown too far backwards to serve the purposes of feet. In a few instances, as in apes and bears, the form and proportion of the several parts of the sacral extremity nearly resemble those of man, except that the heel is raised more above the ground in walking. In the majority of quadrupeds, however, the thigh-bone is very short, and projects but little from the body. Many quadrupeds also want the fibula. Here we must notice a particular construction that prevails in the ruminating quadrupeds, and those of the horse tribe, both in the atlantal and sacral extremities. What is properly the knee in all these animals, that is, the conjunction of the thigh bone and tibia, is situated far up the limb, and is entirely hidden by flesh; but there is a long metacarpal or metatarsal bone, called in veterinary anatomy the *cannon*, and the carpus is improperly termed the knee. From the distant extremity of the *cannon* commences the foot, consisting, as in man, of three phalanxes, called in the horse the *great pastern*, the *little pastern*, and the *coffin bone*. Thus these animals rest on the point of the toes.

There are no sacral extremities in cetaceous animals. In birds they resemble those of man and quadrupeds, consisting of a moderately long cylindrical thigh-bone, a tibia, to which, in some instances, there is added a small slender fibula, closely adhering to the tibia, a single long metatarsal bone, articulated with the tibia, without the intervention of a tarsus, and generally either three or four toes. These toes are differently situated in different tribes. Some, as the ostrich and the plover, have them all pointing forward; a few, as woodpeckers, have two directed forwards, and two backwards; but, in most instances, three of them stand forwards and one backwards.

Almost all reptiles have sacral extremities when arrived at their perfect state, one of the most remarkable exceptions to this rule being the *siren*. In their general structure they resemble those of quadrupeds.

Fishes cannot be said to have sacral extremities, though their abdominal fins have sometimes been represented as analogous to those organs.

We have now noticed all the bones of the skeleton, except one attached to the tongue, which we shall mention when describing that organ, some small bones, constituting a part of the internal organ of hearing, to be noticed under Sensation, and the teeth, which will be considered under the head of Mastication. In reckoning up all the bones that compose the human skeleton, we find them to amount to about 240.

The proper moving organs of the animal body are the muscles. These are bundles or masses of fleshy fibres, of a red colour in the warm-blooded animals, and of a whitish colour in the cold-blooded. They are generally found next the surface of the body, covering the skeleton, but a few of them are within the principal cavities; and indeed there are but few of the soft organs of which muscular fibres do not form a part. A large and strong muscular expansion separates the chest from the belly, and the heart itself is principally a large hollow muscle. It is with the external muscles, however, which are attached to the bones, that we are now chiefly concerned.

The muscles are generally composed of two parts; one called the belly of the muscle, composed entirely or chiefly of fleshy fibres, collected together first into small bundles, and these again into larger, and arranged for the most part parallel to each other; the other a white glistening substance, similar to ligament, and called *tendon* or sinew, which sometimes terminates the muscle at one extremity, in a few instances at both, and is sometimes extended along one side, into which the bundles of fleshy fibres are inserted.

Most of the muscles are attached to bones, generally by both extremities, and as in many instances one of the bones is more moveable than the other, the attachment of the muscle to the less moveable bone is called its *origin*, and that to the more moveable bone its *insertion*.

In classing the muscles according to their real or supposed offices, those which bring two bones nearer together have been called *adductors*; those which draw them more apart *abductors;* those which bend a joint are denominated *flexors;* those which extend it *extensors;* and when two muscles, or two sets of muscles, act in opposition to each other, they are said to be *antagonists*.

Muscles have also received various names according to the direction of their component fibres. Thus, when the fibres run in a longitudinal direction they are called *straight muscles*, and when they run in an inclined direction the muscle is called *oblique*. In the latter case there is sometimes a middle tendon with fibres inserted obliquely into it on each side, forming what is called a *penniform* muscle; in a few cases there are two or three origins, and only one insertion, to a muscle. In this case it is said to have two or three heads, and is called *biceps* or *triceps*.

In enumerating the muscles of the human body, we shall adopt nearly the arrangement of Albinus dividing the body into regions, and noticing the principal offices of the muscles which are situated in each region, premising, that, as the body is divisible into two equal and similar halves, the muscles are enumerated in pairs, as they are generally situated on both sides of the body.

Two pairs occupy the skull, and serve chiefly to contract the skin that covers it; these are called *occipito-frontales* and *corrugatores supercilii.* Eight muscles occupy the space about each eye, and within each orbit, viz. one for closing the eye-lids, *orbicularis palpebrarum;* one for raising the upper eyelid, *levator palpebræ superioris;* and six for moving the eye-ball in various directions, *rectus attollens oculi, rectus deprimens oculi, rectus adducens oculi, rectus abducens oculi, obliquus superior oculi*, and *obliquus inferior oculi.* One pair is situated on the nose, and called *compressores narium*. Eleven pairs are situated about the ear, or within its internal cavity, viz. *attollentes aurem, anteriores auriculæ, retrahentes auriculam, tragici, antitragici, majores helicis, minores helicis, transversi auriculæ, externi mallei, tensores tympani, stapedii.* Eight pairs and one simple muscle form the fleshy part of the cheeks and lips, acting chiefly upon the latter, viz. *Levatores angulorum oris, levatores labii superioris alarumque nasi, depressores labii superioris alarumque nasi, depressores labii inferioris, depressores* *angulorum oris, zygomatici, buccinatores, levatores labii inferioris*, and *orbicularis oris*. Connected with the lower jaw more immediately are four pairs; two which draw it directly upwards, the *temporal* and *masseters*; and two which, acting separately, move it to a side, while together they assist the former, *pterygoidei externi* and *interni*. Connected also with the lower jaw, and generally drawing it downwards, are four pairs, *biventres maxillæ, mylo-hyodei, genio-hyodei*, and *genio-hyo-glossi*. Connected with the tongue and back of the mouth are ten pairs, and one single muscle, viz. *linguales, hyo-glossi, stylo-glossi, stylo hyoidei, stylo pharyngei, circumflexi palati mollis, levatores palati mollis, palati-pharyngei, constrictores pharyngis, constrictores isthmi faucium*, and *azygos uvulæ*; the three first pairs of which perform most of the motions of the tongue, while the rest assist in the act of swallowing. Eleven pairs are connected with the larynx, or top of the wind-pipe, and may be called muscles of the voice, though many of them assist in swallowing, viz. *Crico-thyroidei, crico-pharyngei, crico-arytenoidei, stylo-thyroidei, thyro-hyoidei, thyro-epiglottidei, thyro-arytenoidei, thyro-pharyngei, thyro-staphylini, arytenoidei, aryteno-epiglottidei.*

Seventeen pairs are situated about the neck, and more or less attached to the head, viz. *sterno-thyroidei, sterno-hyodei, latissimi colli, sterno-mastoidei, omo-hyoidei, coraco-hyoidei, longi colli, trachelo-mastoidei, splenii capitis, recti capitis interni, recti capitis lateralis, recti capitis postici majores* and *minores, complexi, obliqui capitis superiores* and *inferiores*, and *trapezii*. Of these the first five, when acting in pairs, draw the head downwards, while acting singly they turn the head to one side, and most of the rest turn the head round upon the neck. Many of them also assist in swallowing. The last of them, acting together, draw the head and bend the neck backwards.

Besides these there are twenty-two pairs or sets of muscular fibres on each side, covering the back of the neck, the back, breast, loins, and belly, which are not connected with the head or extremities, but serve to perform the principal motions of the spine, act upon the ribs in respiration, and form the walls of the belly. These are, *interspinales colli; spinales cervicis; intertransversarii colli; transversales cervicis; cervicales descendentes; multifidi spinae; semi-spinales dorsi; serrati postici, superiores* and *inferiores; scaleni; levatores costarum duarum; quadrati lumborum; sacro-lumbales; longissimi dorsi; psoae parvi; obliqui externi abdominis; obliqui interni abdominis; transversi abdominis; recti abdominis; triangulares sterni*, and *intercostales externi* and *interni*.

Five pairs, and one single set of fibres, are also found about what is called the perinæum, acting chiefly on the rectum and genital organs, viz. *coccygei; curvatores coccygis; levatores ani; sphincter ani; acceleratores urinae*, and *transversales perinaei*.

About forty-five pairs, and several sets of muscular fibres, are connected with the atlantal extremity, from the shoulder to the fingers. Of these five pairs act more immediately on the scapula, as the *subclavii, rhomboidei, levatores scapulae, serrati antici, serrati majores*; ten pairs are inserted into the humerus, which they move in every possible direction, according to their situation and the direction of their fibres; viz. *deltoidei, pectorales, supraspinati, infraspinati, teretes majores* and *minores, subscapulares, coraco-brachiales, tricipites*, and *latissimi dorsi*; eleven pairs are concerned chiefly in the motions of the fore-arm, bending or extending the elbow, rolling the radius, so as to place the hand in the prone position, or with the palm downwards, or in the supine position with the palm upwards, and occasionally they act upon the humerus and *carpus* or wrist, as the *bicipites brachii, brachiales interni, radiales externi, supinatores longi, ulnares externi, anconei, supinatores breves, ulnares interni, radiales interni, pronatores teretes*, and *pronatores quadrati*; and nineteen pairs are concerned in the various motions of the fingers, viz. *extensores communes digitorum, extensores majores pollicis, extensores minores pollicis, abductores longi pollicis, flexores longi pollicis, abductores breves pollicis, opponentes pollicis, flexores breves pollicis, adductores pollicis, sublimes profundi, palmares longi, palmares breves, indicatores, abductores indicum, extensores digitorum minimorum, abductores digitorum minimorum, flexores parvi digitorum minimorum, adductores metacarpi digitorum minimorum*; besides several bundles of muscular fibres, called *lumbricales* and *interossei*, lying in the palm of the hand, and partly between the metacarpal bones.

About forty-eight pairs or bundles of muscles are connected with the sacral extremity, reckoning from the pelvis to the toes. Of these, ten pairs lie chiefly in the region of the pelvis, and are attached to the thigh-bone, which they move in various directions, and, when that is fixed, assist in bending the body. These are, the *psoae magni, iliaci interni, glutei magni, medii* and *minores, pyriformes, gemini, obturatores interni, pectinei*, and *obturatores externi*. Fourteen pairs are seated chiefly on the thigh, and act partly on the knee-joint and partly on the thigh, or even the trunk of the body, viz. *quadrati femorum, bicepites crurum, semi-tendinosi, semi-membranosi, tensores vaginae femorum, recti crurum, sartorii, vasti externi* and *interni, crurales, adductores longi femorum, adductores breves femorum, adductores magni femorum*, and *graciles*. Twelve pairs lie chiefly on the leg, and act, some on the knee-joint, some on the foot or toes, and some occasionally on either, according as the one or the other may be more fixed. These are the *gemelli, solei*, (both forming the chief part of the calf of the leg) *plantares, poplitei, flexores longi digitorum pedis, tibiales postici, flexores longi pollicum pedum, peronei longi* and *breves, extensores longi digitorum pedum, peronei tertii, tibiales antici*, and *extensores proprii pollicum pedum*. The rest, amounting to eight pairs, and several independent bundles, are found about the foot and between the toes, of which they regulate the motions, viz. *extensores breves digitorum pedum, flexores breves digitorum pedum, abductores pollicum pedum, abductores digitorum minimorum pedum, flexores breves pollicum pedum, adductores pollicum pedum, transversi pedum, flexores breves digitorum minimorum pedum, lumbricales pedum*, and *interossei pedum*.

Thus it appears that there are above four hundred distinct muscles in the human body, of which the greater proportion is concerned in the motions of the head and face and the extremities.

The physiology of the muscular motions is of considerable importance; but we must here confine ourselves to general remarks. When a muscle acts, its fibres contract and are shortened. Hence the whole muscle swells, becomes broader and thicker, while its whole length is proportionally diminished, and it feels to the touch harder and tenser than in its natural state.

The shortening of muscles, by the contraction of their fibres, is in proportion as they are inserted more obliquely into the tendon. Hence we see the reason why most of the muscles of the human body are composed of oblique fibres, since a small contraction of the fibres may produce a considerable action of the whole muscle. Again, a muscle composed of opposite oblique fibres, or what is called a penniform muscle, acts with much greater force than one which has but a single row of oblique fibres.

All those muscles that are inserted into bones, are thus furnished with levers; and as in levers in general the action is different, according to the relative situation of the fulcrum, the power and the resistance, the same takes place in the muscular motions of the animal body. Thus, when the head moves backwards and forwards on the atlas, the fulcrum furnished by this bone lies between the resistance, that is, the weight of the head and the power, that is, the contracting muscles, as in what the writers on mechanics call a lever of the first kind. Again, when the heel is raised by the action of the muscles composing the calf of the leg, the resistance represented by the pressure of the *tibia* upon the *astragalus*, is between the power acting at the heel and the fulcrum at the toes, or the lever is of the second kind. Lastly, when we raise a weight held at the palm of the hand, by bending the elbow we use a lever of the third kind, in which the power exerted at the elbow is between the resistance at the palm of the hand and the fulcrum at the lower end of the *humerus*.

The motions of the bones, as produced by the muscles, are the combined effect of different forces, and hence a small number of muscles is capable of producing, with steadiness and accuracy, an almost infinite variety of motions by the various combinations in which they act. Thus we have seen, that only about forty-five muscles are required to produce the infinitely varied motions of the human arm and hand, by which so many ingenious arts are exercised, and such wonderful examples of mechanical genius are produced.

The contracting power of muscles is said to be owing to their irritability, or the capacity of being excited to action by an external stimulus. This property is supposed to be peculiar to muscular fibre, and continues to reside in the muscles of some animals for some time after the life of the animal is extinct. This is the reason why the parts of an eel, the heart of a frog, or the head of a tortoise, moves for some time after it is separated from the body; and hence the Galvanic influence throws the muscles of an animal newly killed into contraction.

In the comparative anatomy of the muscles, we may remark, in the first place, that the flesh of all warm-blooded animals is more or less red like that of man, and the general structure and position of the muscles are very similar in all these classes. There are some quadrupeds that have fewer muscles than man, but in the greater number there is a very important fleshy expansion, called the *subcutaneous muscle*, or fleshy panicle, which is attached to the skin, and serves to contract or wrinkle it when the animal wishes to shake off insects or crush them between the folds of his skin, The muscles of birds are said to possess less irritability than those of quadrupeds, and their tendons are often bony. Most reptiles, except those which have very long or prehensile tails, have fewer muscles in proportion to their size; but in serpents the muscles are extremely numerous. In both these classes the muscles are of a pale colour; but in most fishes they are white, are destitute of tendons, are proportionally larger than those of other animals, and are disposed in layers or flakes. In some of the crustacea, especially crabs and lobsters, there are very strong and large muscles, that move the claws and tail. Insects, though so full of motion, possess but few muscles, except in their *larva*, or caterpillar state, in which they are extremely numerous. In the mollusca, on the contrary, muscles are generally nnmerous, and in some instances very strong, particularly in the shell fish. The muscles of worms resemblo those of larvæ, or caterpillars.

There are some organs of motion found in the inferior animals different from those we have described in man. Thus, a great proportion of quadrupeds, all cetaceous animals, all birds in a greater or less degree, most reptiles, all serpents, and all fishes, have a tail which performs many important offices. In certain cases, as in some monkeys, in opossums, and in chameleons, it performs the office of a hand, and enables the animal to take a firmer hold on branches of trees, &c.; in all those animals that swim, it serves the purpose of an oar or a rudder, to impel them forward or regulate their course; in birds it has great effect in assisting and regulating their flight; and to almost all animals it becomes a useful defensive, and to many a very formidable offensive weapon.

Some quadrupeds, as the rhinoceros, the tapir, and more especially the elephant, have the snout prolonged into a proboscis, or trunk, which admirably supplies the place of hands in seizing objects and gathering their food.

In several of the mollusca there is a fleshy organ called the foot, which greatly assists the animals in their progressive motions, or in their endeavours to find a speedy retreat from danger.

Among the crustaceous animals and insects there are several peculiar organs of motion, of which we may particularise the large claws in crabs and lobsters. These are used not so much for progressive motion as to seize the animal's prey, and to break the hard shells in which it is commonly contained. Thus they serve the purpose both of hands and teeth, becoming at once organs of motion and of mastication. Similar organs are found in several insects, and many of these have a proboscis or trunk.

We are now to explain the progressive motions of animals, or the actions of walking, leaping, running, climbing, flying, and swimming; but we must, in the first place, make a few remarks on the attitude of standing.

To stand erect, whether on two legs or four, nothing more is required than to exert the extensor muscles of the legs, so as to preserve the equilibrium of the body. It is evident that quadrupeds have in this respect a great advantage over man, and more especially over birds; and hence we find the reason why the extensor muscles of the thigh are proportionally stronger than those of all other animals. Hence, too, we see why it is so difficult for dogs, bears, and some other animals, which are occasionally exhibited in the attitude of dancing, to support themselves long in that awkward and unnatural position. The long-necked birds would find it extremely difficult to support themselves in a standing position, especially on one foot, in which attitude they commonly sleep, were it not for a particular mechanism of the metatarsal bones, consisting of a particular eminence, which shuts into a socket at the end of the *tibia*, in such a manner as to oppose the flexion of the joint, and thus keep the limb in a steady position.

In standing on four feet, the atlantal extremities support the greater part of the weight of the body, as from the great weight of the head and neck in most quadrupeds, the centre of gravity is thrown forwards.

In the action of walking the centre of gravity is alternately moved by one part of the extremities and sustained by the other, so that the body is never at one time completely suspended above the ground. In walking on two legs the animal first advances one foot, so that the advanced leg makes an obtuse angle with the tarsus, while that behind makes an acute angle. From the resistance of the ground to the foot behind, it is necessary to raise the heel and leg; and to do this, the trunk, supported on the *pelvis*, is moved upwards, forwards, and a little to one side, moving round the fixed foot as a centre. Thus the other leg is thrown forward, and rests its foot upon the ground, while the other now forms an acute angle with its leg, and gives occasion to a similar motion of the trunk on the other side. In these motions the extensor muscles act first, and the flexors immediately after. As the undulatory motion that necessarily attends walking cannot be perfectly regulated on both sides, it is evident that a person cannot walk on a perfectly straight line, and that to walk in a direct course requires the assistance of the eyes. Hence we find, that in the experiments which are sometimes made to walk or drive a wheel-barrow directly to a certain object blindfold, the attempt is uniformly unsuccessful.

In walking upon four feet, the quadruped first slightly bends the hind legs and then extends them so as to throw the body forward; and now, as by this motion the fore legs incline backward, the animal would fall if he did not throw forward the fore legs to support him. When this is done the body is drawn up on the fore legs, and the former motions repeated. In this motion, however, the two fore legs, or the two hind are never used at once; but the step is performed by one leg belonging to the hind and one to the fore pair, though these are not always of the same side. Those animals which have their fore-legs considerably shorter than their hind, as jerboas, kangaroos, hares, rabbits, and frogs, rather leap than walk.

In *leaping*, the body is for a time raised completely from the earth. This action is performed by first throwing the sacral articulations into an unusual degree of flexion, and then suddenly and strongly exerting all their extensor muscles. The force and extent of the leap depend on the proportional length of the bones and strength of the muscles. Hence those animals that have the sacral extremities considerably longer and thicker than the atlantal, leap the best. The smaller the animal, too, the greater proportionally is the leap; and perhaps there is no animal that exceeds the flea in the length and agility of leaping, it being computed, at a moderate leap, to measure 200 times its own length.

Several animals that have no feet perform a motion analogous to leaping; that is, they spring from the surface on which they are moving into the air. Serpents do this by folding up their bodies in a spiral form, and then suddenly uncoiling them. Salmon, and some other fishes, leap up cataracts, by bending their bodies as much as possible, and then unbending them by a strong elastic spring. Shrimps, and other cray fish, leap by suddenly extending the tail after it has been bent beneath the body; and maggots spring to a distance, by arching their bodies nearly into a circle, and suddenly relaxing them into a straight line.

Running differs from leaping, inasmuch as it is performed by the alternate progression of each leg, while it differs from walking in the body being projected forward at each step, and the hind foot being raised before the other touches the ground. It consists in a series of low bounds, in which the body is inclined forward, in order to place the centre of gravity in a position proper for receiving an impulse from the hinder leg, while the fore leg is moved rapidly forward to prevent falling. The trotting and galloping of quadrupeds are running upon four feet, and they differ from each other in the mode of raising the feet. In trotting, the diagonally opposite feet rise at once and fall at once, each diagonal pair alternately, but so that for a moment all the feet are off the ground. In galloping, the animal raises the fore feet at each step, and throws forward the body by the extension of the hind feet. When the two fore feet touch the ground a little after each other, it is called a canter; when both fore feet touch the ground at once, and are followed by the two hind feet also touching the ground at once, it is a full gallop.

Climbing consists in hanging from and strongly grasping any object capable of being seized by the fingers, toes, or tail, and by successive efforts raising the body in opposition to its weight. Hence those animals are the best climbers that have their paws and feet most deeply cleft, their divisions most flexible, or their claws longest and sharpest. Man is but an indifferent climber, as he can make no use of his feet in this action, and can only grasp the object with his legs, while he holds by his hands. Among quadrupeds, apes and lemurs climb the best, from the form of all their fore feet being similar to that of the human hand. Cats also climb well from the sharpness of their claws. Of birds, woodpeckers, nut-hatches, and those called creepers, also climb by means of their sharp talons. Lizards, chameleons, and some other reptiles, climb well, partly from the length and flexibility of their toes, and partly, in some of them, from the prehensile property of the tail.

Flying, properly so called, is performed only by birds and insects. It may be considered as a succession of leaps, assisted and prolonged by the resistance given to the air by the wings and tail. In commencing its flight, a bird leaps either from the ground or from some elevated object, and unfolds its wings in a horizontal direction. It then suddenly depresses the wings, so as to form an angle with the vertical plane of the body, and the resistance afforded by the air to this motion produces a re-action on the body of the bird, and impels it forward. These actions are repeated; and as long as the wings thus act the bird ascends; and when it wishes to descend, it has only to intermit the action of the wings, and either fall by its own gravity or descend gradually by occasional lesser vibrations. In flying horizontally, a bird does not move long in a straight direction, but describes a succession of curves, alternately ascending and descending in an oblique course. The action of the tail in flying is various. When it is depressed, it impels the bird upwards, and *vice versa*; and when moved to one side or to the other, it assists in turning the bird's body in an opposite direction.

Butterflies, and other winged insects, are, from the lightness of their bodies, easily supported in the atmosphere by means of the gentle and continued vibrations of their wings.

Several animals besides these imitate the motion of flying. Bats, flying lemurs, flying squirrels, and flying dragons, have a membranous expansion extended between the phalanxes of the fore toes, and sometimes from these to the thighs, by means of which, when they leap from one tree, they are easily supported in their gradual progress towards another. The motion of the flying-fish, by which it raises itself from the water and remains for a short period in the air, as some suppose, more nearly resembles flying than that of the last-mentioned animals; but it is worthy of inquiry, whether the motion of the flying-fish out of the water ought to be considered any thing else than a long leap, which the great length of its pectoral fins enables it to take.

Swimming is performed by a great variety of animals besides fishes. It is probable that almost all quadrupeds are capable of this motion; and we know that the bulkiest among them, the elephant and hippopotamus, swim with great facility. Many of them, as seals and walrusses, are even considered as amphibious; and the polar bear passes much of its time in the water. Among the birds, all those that are web-footed naturally swim; and there are few reptiles to whom this motion is not familiar. The action is of course differently performed, according to the shape and habits of the animal. Quadrupeds and birds swim by employing their feet as oars or paddles, and probably their tail as a rudder. Cetaceous animals, seals and walrusses, impel their bodies through the water by paddling with their atlantal extremities or paws, and moving their sacral extremities or tail in various directions, according to the required velocity and line of their course. Of reptiles, frogs swim in a manner similar to man, by throwing their fore legs forward and their hind backward at the same time.

Fishes, however, are the only animals that swim with perfect ease, as the form of their bodies, the number of their fins, and the air or swimming bladder, with which most of them are provided, all contribute towards this purpose. They are impelled through the water chiefly by the pectoral and ventral fins, and by the broad vertical fin that terminates the tail, while the swimming bladder, as it is more or less compressed by its appropriate muscles, increases or diminishes their specific gravity, and thus enables them to descend or ascend at pleasure. The air bladder is so important an organ in the economy of fishes, that we find those in whom it is wanting, as the flat fish, always remain near the bottom, though their fins enable them to make way through the water horizontally.

Chap. II. Of Sensation.

The organs of sensation are either general or particular. The former, commonly called the *nervous system*, comprehends the *encephalon*, the *spinal marrow*, and the *nerves*; the latter constitute the organs of the senses.

Sect. I. *Of the Nervous System.*

All the brainy mass contained within the cavity of the skull is hence called *encephalon*. It consists of various parts; and a perpendicular section longitudinally through its middle divides it into two equal and similar halves. On cutting through the frontal, temporal, parietal, and occipital bones, by a horizontal section just above the eyes and ears, and removing these bones, we first observe a dense and thick vascular membrane, called by anatomists *dura mater*, which adheres to the bones in various parts, but more especially to the upper longitudinal line, extending from the nose to the occiput. On cutting through this membrane, after the manner of the former section, we find that its middle longitudinal upper part is prolonged downwards, forming a partition between the two halves, or, as they are called, hemispheres of the brain. This mass, now brought into view, displays, through a thin membrane that lies over it, numerous undulating prominences which are enveloped in a very fine transparent membrane, and are of a reddish grey colour. These are the convolutions of the brain. On extending our examination downwards, we find that the two hemispheres are flattened, and pretty smooth, where they were divided by the *dura mater*, and that they are joined near the middle by a central part more solid than the rest. This is called the *callous body*.

On cutting into the substance of the brainy mass, we perceive that it is composed of two very different substances, one external, of a reddish grey colour, called the *cortical* or *cineritious matter*, the other forming the internal or central part of the mass, white and pulpy, though, on a close and careful examination, it is found to be composed of very delicate fibres. This latter has been called the *medullary* substance.

On raising the back parts of the two hemispheres, we find them supported by an expansion which forms a horizontal partition between what is usually called the brain, and a lesser portion of the encephalon, called *cerebellum*, or little brain. This is also composed of two parts, or lobes, united by a middle central portion, and this latter joins the central portion that unites the hemispheres of the brain. On removing the whole brainy mass from the skull, by cutting it across at the bottom of the great occipital hole, and dividing a number of white cords, by which it is connected to the base of the skull, we find that its lower side, which rested on the base, is extremely irregular. In the first place, we see a conical or pyramidal part, which filled up the occipital hole, and which, by some writers, is considered the commencement, by others the termination of the encephalon, and which has been called the *oblong medulla*. Behind this lies the cerebrum, to the fore-part of which the pyramidal portion is united by transverse parts, called *crura*, or legs, and before is seen a transverse broad portion, called *annular tuberosity* or *bridge of Varolius*. Farther on lies a spherical body, called *pituitary gland*. We also see that the lower surface of the cerebellum is marked with circular prominent lines, while the lower surface of the proper brain has convolutions similar to those above. This latter is also seen divided into three unequal parts on each side, the *anterior lobes* lying on the frontal bone, the *middle lobes* lying over the temporal and sphenoidal bones, and the *posterior lobes* lying partly on the occipital bone, and partly on the membrane that separates them from the cerebellum. On cutting vertically into the substance of the cerebellum, we observe an appearance resembling a shrub, that is, a middle white trunk, from which numerous branches pass off on each side; this has been called *arbor vitæ*, or the tree of life.

When we examine more minutely the internal structure of the brain, we find that its substance is in several parts separated, so as to form cavities called *ventricles*. Of these cavities anatomists have enumerated four, sometimes five. The two nearest the upper surface are called *lateral ventricles*, as they lie on each side of the middle *callous portion*, and are separated by a thin pellucid double partition, which terminates below in an arch covering the third ventricle. The fourth is more deeply situated, and farther back. On what is called the *floor* of the lateral ventricles, are several prominences that have received particular *names*, especially *optic thalami*, or apparent origin of the optic nerves, and two long vascular bodies which approach each other towards the fore-part, where they pass through a hole leading to the cavity below. All these cavities communicate with each other, and are often found containing a watery fluid. A little behind and below the lateral ventricles are found five remarkable protuberances, one of which is the *pineal gland*, which was formerly supposed by philosophers to be the seat of the soul.

The *dura mater* is composed of two layers, and forms numerous cavities within its doublings. These are called *sinuses*, and in the living body are filled with blood. One is situated longitudinally at the top of the head, the *superior longitudinal sinus*, and one on each side of the body of the sphenoidal bone, the *lateral sinuses*.

The size of the human brain varies in different individuals, but, in general, it is proportionally larger in a young person than in an adult. The largest brain of an adult man weighs about four pounds, and the smallest about two pounds and a half. On a medium calculation, the human encephalon bears to the size of the whole body the proportion of one to twenty-seven. Of the whole brainy mass, the brain, properly so called, is about nine times the size of the cerebellum; and, of these nine parts, about six are occupied by the hemispheres, or general substance, while the rest comprehends the part more immediately connected with the nerves.

The *spinal marrow* is that substance continuous with the oblong portion of the encephalon, which fills the canal formed by the junction of the large central holes in the vertebræ of the spine. It is similar in structure to the encephalon, except that the whiter part of its mass is exterior, and it is enveloped in similar membranes. Towards its lower, or sacral extremity, it is divided into numerous fibres, supposed to resemble a *horse's tail*.

Connected with the encephalon and spinal marrow, but whether arising from these or terminating in them we shall not determine, as these are disputed points, are numerous white pulpy cords, of very different sizes, and most of them connected with each other, either by cross filaments, or rounded, enlarged portions, called ganglions. These are the nerves, and they appear in pairs, one on each side of the encephalon and spinal marrow. They are surrounded by membranes, similar to those of the general brainy mass, except at their minute ramifications.

There are generally reckoned ten pairs of nerves connected with the encephalon, and passing through the holes that are seen in the base of the skull. The two that are most forward are undivided, and pass to the nose through the holes of the ethmoidal bone. These are called the *olfactory* nerves, or nerves of smelling. Immediately behind these are two larger nerves, which meet each other, apparently unite their substance, and pass separately, one to each orbit, to be distributed on the interior of the ball of the eye. These are called the *optic* nerves. The third and fourth nerves also enter the orbits and supply the muscles of the eye-ball. The fifth pair consists of three bundles, of which one goes to the orbit, a second supplies the greatest part of the upper jaw or face, and the third the lower jaw. The sixth pair is distributed chiefly on a particular muscle of the eye-ball. The seventh pair, or what by some is called the first portion of the seventh pair, supplies the internal cavity of the ear, and is thence called auditory nerve. The eighth pair, or second portion of the seventh, is distributed externally on various parts of the face, and is thence called facial nerve. The ninth pair, according to some the eighth, is chiefly distributed on some of the important organs of the chest and belly. The tenth pair, by some called the ninth, is distributed on the tongue and organs of speech, and is called *lingual* or *hypo-glossal.*

Thirty principal nervous trunks are immediately connected with the spinal marrow on each side, passing through holes in the interstices of the vertebræ. Of these spinal nerves, the three highest supply the sides of the neck and head; the five next unite together in a large *plexus* or net-work, and afterwards form a considerable trunk that is branched out on the atlantal extremity; the twelve next supply the spaces between the ribs; and five, or, according to some writers, seven, between the ribs and *sacrum*, conspire to form two considerable trunks that supply the sacral extremity and parts adjacent.

Besides these, there is a very important nerve, or series of communicating nerves, called the great *sympathetic*, formed chiefly by a nervous cord extending from the head to the sacrum, passing on each side through the neck, chest, belly, and pelvis, and communicating, through the medium of *ganglions*, *plexuses*, and nervous filaments, with almost all the nerves of the body.

We have seen that all the vertebral animals have an encephalon; but this is very different in its structure and proportion in the different classes. The brain of the *mammalia*, indeed, nearly resembles that of man; and in a few instances, as in the ape tribe, is nearly as large in proportion to the body. In most quadrupeds, the anterior lobes of the brain are lengthened out into processes, terminated by the olfactory nerves, and in many instances the partition formed by the dura mater between the brain and cerebellum assumes a bony texture. The convolutions on the surface of the brain are often less numerous than in man, and the proportional size of the cerebellum is considerably greater.

In the cetaceous animals the brain is generally smaller, in proportion to the body, than in quadrupeds; but its substance is denser and more evidently fibrous, and the distinction between the cineritious and medullary substance is extremely well marked. The lateral ventricles and optic thalami are proportionally large. The spinal marrow in these animals is very small.

The brain of birds is often larger, in proportion to the body, than in man and quadrupeds, but it is very differently formed. It is smoother in its surface, and the optic thalami, instead of being within the lateral ventricles, lie behind and below those cavities forming a part of the lower surface of the brain. The *dura mater*, too, in this class, is scarcely ever produced between the hemispheres, and there is no callous central portion, or annular tubercle, and probably no pineal gland.

In reptiles and serpents the brain is small and simple, consisting of five roundish eminences, two hemispheres, two nervous thalami lying behind them, and a simple cerebellum, that exhibits no appearance of the arbor vitæ. The dura mater forms no processes. In these animals, however, the spinal marrow is, proportionally, much larger than in the superior classes.

In fishes the brain is very small, and does not fill the cavity of the skull. It is constructed in a manner similar to that of reptiles, and is surrounded by a simple undivided *dura mater*. In most of these animals the trunks of the optic nerves evidently cross each other.

The common centre of the nervous system, or common *sensorium*, as it has been termed, consists in *crustacea* and *insects*, of a medullary cord, interspersed with knots, or ganglions, running through the body, and being generally a little larger towards the head. In the *larvæ* of some insects this enlarged part is double, and is supposed to resemble a brain.

In some *mollusca*, as the cuttle-fish, the nervous cord is double from the head downwards. In *worms* it resembles that of the larvæ of insects.

The nerves of *quadrupeds* nearly resemble those of man, except that they are larger in proportion to the brain. In *cetaceous* animals the *olfactory nerves* are wanting. In the inferior classes, the nervous trunks are less numerous and more simple, as we descend to *zoophytes*, in which no such cords appear.

The brain is allowed on all hands to be the centre of sensation and of intellect. These faculties, however, do not keep pace with each other. Many of the inferior animals excel man in the acuteness and delicacy of some of their senses. The scent of the hound, and the sight of the eagle are proverbially superior, and it is probable that the *taste* of many animals is more discriminating, if not more delicate than ours. But no animal, not even the elephant, can rival man in his intellectual powers, and none possesses like him the rational faculty of speech. To what is all this owing?

We have already hinted at a division of the common sensorium, into that part which occupies the upper and middle parts of the skull, and that which lies upon the base, and gives out or receives the nerves, and have stated, that, in many, the former is at least twice as large as the latter. If we suppose with Soemmering, that the former portion is the centre of intellect, and the latter that of sensation, we may conclude that, all other things being equal, the measure of intellect or mind possessed by an animal, is to be estimated by the proportional size of the upper part of his brain. Man exceeds all other animal in this respect; and we find that in proportion as he approaches the inferior animals in the lowness of the forehead and the flatness of the crown, the more he descends in the degree of intellectual powers.

Respecting the offices which the common sensorium performs in the animal economy, we are still very much in the dark. That the brain is a secreting organ, forming a peculiar fluid that is conveyed along the nerves, and therefore called the nervous fluid, is at least highly probable, and that through this organ we receive from without, and exercise the several voluntary functions of the body, is generally allowed; but how these communications take place, and especially how mind is connected with body, we never have been, and perhaps in this state never shall be, able to determine.

There are, however, certain established facts or principles respecting the physiology of the nervous system, which it is necessary here to notice. Thus, we find that the nerves which supply the organs of the senses communicate immediately with the brain, while those which supply the organs of voluntary motion communicate more directly with the spinal marrow; that when pressure is made upon a nerve, a numbness, and loss of motion or of action in the part to which the nerve leads is the consequence; that when pressure is made on the spinal marrow, all the parts below the seat of the pressure have their sensibility and mobility diminished or destroyed, and that pressure on the brain itself is attended with more or less of general torpor and paralysis. It is probable that the real seat of sensation is the brain, or centre of the nervous system, though we commonly refer the sensation to the extremity of the nerve most remote from the sensorium, as when a person who has lost his leg occasionally feels pain at the stump, which he refers to his toes.

Various sympathies which take place in the animal economy are explained from the connection of nervous filaments. Thus, when we know that branches from the fifth pair of nerves supply the nostrils, the scalp, and the eyes, we shall not be surprised that violent scratching of the head, as with a sharp comb, produces sneezing, and that the sudden inhalation of pungent odours excites a copious secretion of tears.

An intimate connection is found to subsist between the nervous and the muscular systems. Thus children and delicate people, who possess unusual sensibility, have also a more irritable muscular fibre, or are more subject to spasmodic and convulsive diseases. Again, whatever increases the sensibility of the muscles, increases also their irritability, and *vice versa.*

It has lately become fashionable to explain the temper, dispositions, virtues, and vices, both in man and inferior animals, from the prominences of the brain, as shewn externally, by the corresponding inequalities of the skull. A person whose head is unusually prominent at its upper middle part must be remarkable for piety; one whose skull projects more than is ordinary above the ears, is disposed to murder his fellow creatures; and one who has the fore-part of his temples more than usually developed, as it is termed, is more witty than his neighbours. Notwithstanding all that has been written and asserted by Messrs Gall and Spurzheim, and their followers, we cannot help believing, that there is more of fancy than reality in this doctrine, and that a great addition of observation and experience is required before we can judge successfully of either our human or brute fellow-creatures from the prominences of their skull more than from the diversity of their features.

SECT. II. *Of the External Senses.*

Physiologists have agreed in limiting the number of the external senses to five, though of late it has been supposed that some animals possess a sixth. The most generally diffused of all these senses appears to be that of *feeling.*

The lowest orders of animals are evidently susceptible of impressions, and probably have a sense of pain and pleasure, though in a degree very inferior to those which possess a visible nervous system. We would say that these animals possess *sensitivity,* but not *sensibility*; and in this respect polypes and other zoophytes are raised but one step above the vegetable kingdom.

Feeling.—The organs of feeling are either general or particular. The general organ, in almost all animals, is the skin, and more particularly that part of it on which the nerves terminate, called the *papillary portion.* To avoid repetition, we shall not at present describe even the human skin, but shall treat of it with the other integuments among the organs of *Integumation.*

The particular organs of feeling are, in man, the hands, and more especially the points of the fingers, which, in some persons, acquire such a delicacy of sensation, as to enable them to read by feeling the impressions made on paper by the types of a printing press. It is probable that the toes have also naturally a considerable nicety of feeling, though in most persons their sensitive power is blunted by pressure and want of habit. We know that young children commonly employ their toes in grasping a finger, or similar object; and those who are without hands employ their toes very successfully as substitutes for those important organs.

Only those quadrupeds called *quadrimana,* including apes and lemurs, appear to employ their fore-paws as organs of feeling, but many of them possess organs of very delicate feeling power. Thus, the trunk of the elephant is able to perform even the nicer actions of the human hand. With this organ the animal unties knots, draws bolts, and we have seen one of them take up a sixpence from the ground, holding it between the lip and margin of its trunk. The lengthened snout of the *rhinoceros* and the *tapii,* seem to answer the same purposes in a less degree. Many quadrupeds have whiskers, by means of which they appear to judge of the diameter of holes through which they have to pass.

In birds, the bill, which is well supplied with nerves, is supposed to be one of their most delicate feeling organs, more especially in those that seek their prey in shallows, or among the mud.

What particular feeling organs are exercised by reptiles we have few means of discovering. In many of them, especially those whose bodies are covered with shells or scales, the sense of feeling cannot be very acute; but it is certain that frogs, toads, and similar soft reptiles, readily perceive the contact of other bodies and it is probable that the feet of the tree-frogs are sufficiently sensible of touch.

Among fishes the lips and the *cirrhi,* or *tentacula,* which project from them in many species, appear to be the principal feeling organs.

In *crustacea* and *insects,* there are two organs, either or both of which may be the instrument of feeling, the *palpi,* commonly called the feelers, and the *antennæ.*

The *tentacula* of mollusca and worms, and the arms of cuttle-fish, star-fish, and polypes, must be considered organs of feeling, as well as means of taking their prey.

By feeling we judge of the roughness or smoothness, hardness or softness, figure, temperature, and other tangible properties of material substances. For the complete exercise of this sense, it is necessary

Sensation.

that the *papillæ* of the skin be soft and flexible, and that the cuticle which covers them be soft and thin.

Tasting.—Tasting is the sense which seems most nearly allied to feeling. Its organs are chiefly the tongue and the palate, though, in some instances, the taste of sapid bodies is not perceived till they have passed these organs, or is most evident in the gullet or the stomach.

The tongue, even in man, is an organ destined to many different purposes, and, on the whole, tasting is not one of the most important. We shall, however, complete our description of it in this place. The human tongue is composed partly of muscle and dense cellular substance, and partly of numerous nervous *papillæ,* of different forms and sizes. Besides its proper muscular fibres, constituting the lingual muscles, there is a considerable irregular mass of flesh above these, and immediately below the nervous *papillæ.* Both the upper and under surface of the tongue is covered with a smooth mucous membrane, below which lies a texture similar to what we shall afterwards describe as one of the *integuments,* consisting chiefly of a net-work of minute vessels, and within this again is the proper skin of the tongue, abounding, especially on its upper surface, with nervous and mucous *papillæ.* What are regarded as the mucous *papillæ* are arranged towards the root of the tongue, where they form an angular groupe, diverging from a point next the root towards the fore part and sides of the tongue. They are of a spherical or oval figure. The nervous *papillæ* occupy about two-thirds of the tongue towards the tip. Some of them are like tubercles, with a narrow neck of a whitish colour, pretty large, but few in number; others are conical, pointed, small, and numerous. These papillæ appear to constitute the immediate organ of taste.

The bony palate already described is covered with a dense, thick, mucous membrane, smooth next the mouth, adhering strongly to the bones, with intermediate mucous and nervous papillæ. From its back part hangs a membraneous curtain, commonly called the *soft palate,* having an oblong glandular body, called *uvula,* hanging from its middlemost depending part, and two other glandular bodies, called *tonsils,* or almonds, connected with the lower part of the membrane at its sides.

Connected with the tongue at its lower part are two glands on each side; one pair, called *sublingual,* as lying immediately below the tongue on each side of the *frænum,* or vertical membrane, that ties down the tongue to the parts beneath; and the other pair called *submaxillary,* attached to the inside of the lower jaw, below the sockets of the teeth. There is another pair of glands called *parotid,* lying one before each ear, and communicating, as well as the two former, with the cavity of the mouth, by hollow tubes or *ducts.* All these glands are called *salivary,* because they secrete the *saliva,* or slaver, a transparent, watery, tasteless fluid, so far necessary to the sense of tasting that all solid bodies must be more or less dissolved in it before they can affect the nervous *papillæ* that constitute the immediate organs of taste.

Hence those substances are in general most sapid which are most easily soluble in the saliva, as acids, salts, sugar, &c.

Though the tongue be regarded as the essential organ of taste, it is certain that the palate materially assists in this sensation, as we find that tasting becomes more exquisite when we press the tongue with the sapid body on it against the roof of the mouth.

The comparative anatomy of the organs of taste is very obscure. We know that almost all the vertebral animals, and many of the invertebral, have a tongue; but in most of them the structure of that organ is such as to fit it rather for the act of swallowing than the sensation of taste. Most of the quadrupeds, indeed all the cetaceous animals, many of the reptiles and serpents, and some of the fishes, have a soft moist fleshy tongue, provided in a greater or less degree with nervous *papillæ*; but as many of these animals swallow their food without chewing, it is probable that in these cases the sensation of taste is very slight. Very few birds, as parrots, and some predacious and water birds, have a soft thick tongue, provided with nervous *papillæ,* and moistened with saliva; but in general, the tongue of birds is horny, stiff, and dry, and supplied with few nerves.

It is probable that the hinder pair of *palpi,* or feelers, in several insects, possesses in some degree the sensation of taste. What is called their tongue seems to be merely intended for taking food.

Smelling.—The immediate organ of smelling appears to be that highly vascular and nervous membrane called by anatomists *pituitary,* which lines the nostrils and adjacent cavities.

The nose in man consists partly of several bones of the skull and face, which articulating together form the walls or sides of the nostrils and part of their internal contents, partly of cartilage, and partly of skin and muscle. The upper part of the nose is formed by the *frontal* and *nasal* bones in front; the *upper maxillary, ungual,* and partly the *sphenoidal,* on the sides; the *sphenoidal* on the back part; the *upper maxillary* forming the base or floor of the nostrils; the *ethmoidal* constituting the greatest share of their upper internal part, and a portion of the long partition that separates the nostrils, with the *spongy* bones hanging on each side, while the rest of the partition is formed by the *vomer,* and a thin cartilaginous expansion extending between this and the *ethmoidal* bone. The lateral parts of the nostrils below the *nasal* bones are formed of a thick, soft, flexible cartilage, covered on the outside with a dense skin with numerous pores.

The nostrils communicate above with the *frontal sinuses,* (or two cavities formed by the separation of the outer and inner plates of the frontal bone in the lower part of the forehead,) behind and below with the mouth, and with the *sphenoidal* sinuses; and at the sides, a little backwards, with the *sinuses* in the *superior maxillary* bones. All these communicating cavities are lined with one continuous *pituitary membrane,* and the same membrane covers the spongy bones within the nostrils and the ethmoidal cells. The surface of this membrane is kept moist by the continual secretion of a mucous fluid, which is increased by the action of irritating substances received into the nostrils during inspiration.

The medium through which odours impart the sensation of smelling is the air, which being inhaled through the nostrils during inspiration, carries with it those minute particles which are continually flying off from odorous bodies, and which are commonly called *effluvia*. If these effluvia be very irritating, they excite sneezing, which consists in a sudden and violent expiration, for the purpose of dislodging the offending matters, the effects of which are also counteracted by the increased secretion of *mucus*.

The organs of smelling in the inferior animals are essentially the same as those in man, but differ considerably in structure and complication in the several classes and tribes. Those quadrupeds which we know to be remarkable for the nicety of their scent, as dogs, cats, bears, and weasels, and several others which we judge to be so from analogy, as the elephant, the hedge-hog, the mole, and the ruminating quadrupeds, have the nasal cavities either very large or very complicated.

The *cetaceous* animals having no *ethmoidal* bone, and no peculiar *olfactory nerves*, are supposed to be very defective in the sense of smelling.

Nor does this sense appear to be very acute in *birds*, as their nestrils are in general small and contracted. The same may be said of *reptiles* and *serpents*.

Fishes, considering the element in which they live, which appears capable to a certain degree of communicating odours, are more remarkable than the two preceding classes for the structure of their smelling organs. Most of them have double nostrils on each side, and their pituitary membrane is elegantly disposed in semicircular folds.

It seems an undoubted fact, that most *insects* possess the sense of smelling, but the organs by which they excercise this sense have not been satisfactorily ascertained.

Hearing.—The organ of hearing is situated in and about the *temporal bone*. It consists partly of internal and partly of external parts, though, in a great variety of animals, the latter are either wanting or extremely imperfect. The external parts are peculiarly fitted for receiving the pulsations of the air by which sounds are produced, and conveying them to the internal cavities, where they are propagated or reverberated, so as to excite the sensation of hearing.

The external ear in man consists chiefly of a cartilaginous substance, variously contorted, covered with skin, and provided with numerous muscles, though in most persons the cartilage is scarcely susceptible of motion. The prominences and depressions of the cartilaginous auricle have received different names, according to their supposed form or their situation. The outer rim is called *helix*, and the inner rim immediately contiguous to this *anti-helix*, and the depression between these two, at the upper part, is called *scapha*, or the boat. The eminence below the upper and fore part of the *helix*, next the face, is called *tragus*, from its being sometimes covered with hair like a *goat's beard*; and the lesser eminence, nearly opposite, in which the *anti-helix* seems to terminate below, is called *anti-tragus*; the depending soft skinny part is the *lobe* of the ear.

From the auricle there is a winding cartilaginous passage, lined with a delicate skin, between which and the cartilage are numerous glands, secreting a thick fatty substance, called the wax of the ear. This winding cavity terminates in a circular bony rim, filled with a firm elastic membrane, resembling parchment, called the membrane of the drum of the ear.

Here properly begins the *internal ear*, which is of a very complex structure. In the first place, there is a small cavity behind the membrane just mentioned, called the drum of the ear, which contains four small hard bones, and has several openings. Two of the bones are connected with the membrane of the drum, and are closely articulated together. One of these is called the *hammer* and the other the anvil. This latter has two processes, of which the shorter is contiguous to an opening leading to cells in the *mastoid* process, while the longer is articulated through the medium of a very minute round bone with the fourth bone, named from its shape the *stirrup*. The openings from the drum are one forwards towards the mouth, into which it opens by a cartilaginous tube called the *eustachian* tube, and two openings inwards, one of which is filled up by the *stirrup* and the other by a membrane.

More internally behind the drum is another cavity, called, from its complexity, the labyrinth. This labyrinth is composed chiefly of three circular hollow passages, within the substance of the bone, called the semicircular canals, and a double spiral cavity, which, from its resemblance to a snail's or periwinkle's shell, has been termed *cochlea*, all communicating with a common central cavity. Through these winding passages are distributed branches of the *auditory nerve*, and the rest of the cavity is filled with a gelatinous fluid.

The vibrations of the air, generated by sounding bodies, being received by the broad expanded hollow of the external ear, are conveyed through the winding passage to the membrane of the drum, on which they strike, and set in motion the little bones behind. These again communicate the pulsations to the gelatinous fluid within the labyrinth, by means of which the auditory nerve becomes affected, and excites in the brain the sensation of sound. Sounds are also partially communicated through the mouth, by means of the *eustachian tube;* for when this tube is obstructed hearing becomes imperfect.

Internal organs of hearing are found in all the vertebral animals, and in a few of the invertebral. Many of the former division also possess external organs more or less perfect; but what are properly called *auricles*, or external ears, are found only in quadrupeds.

We know of only four tribes among the *mammalia* that want the external ears; but this is the case with most seals, walrusses, the mole, and the duck-billed animals. In many quadrupeds again, as the common bat, the elephant, the fennec, the squirrel, and the ass, the ears are remarkably large. The structure of the internal ear in quadrupeds is similar to that which we have described in man.

The cetaceous animals have only a small external auditory passage, and the bony part of their internal ear is but loosely connected with the skull. They have, however, a large eustachian tube; but all the parts of the labyrinth, especially the semicircular canals, are remarkably small. Yet these animals seem

Sensation.

to hear well; a circumstance which is probably owing to the superior power that water possesses of conducting sounds.

In birds there is commonly a very regular arrangement of the feathers round the openings that lead to their internal ears, and their cavities are connected together by air cells passing round the skull, and the eustachian tubes have a sort of common opening in the arch of the palate. These animals have no *cochlea.*

Of the reptile tribes, only the crocodile has any thing like an outer auditory passage. In the rest, the membrane of the drum is either level with the skin, or immediately below it. In some of them the eustachian tube is wanting, and the internal ear is, in other respects, very imperfect.

The organ of hearing in fishes consists chiefly of three large canals, and is farther distinguished from that of the superior animals by its increasing in size according to the age and growth of the animal; whereas in the other classes which we have mentioned, the internal ear is fully developed at a very early period of existence.

Among the crustaceous animals, the cancer tribe have an evident internal organ of hearing, situated on each side at the root of the *palpi*, with a small bony tube by which it communicates with the water.

If we except the cuttle-fish and the animals just mentioned, we know of no invertebral animals that have manifest auditory organs, though it is probable that many of them can distinguish sounds.

Seeing.—The eye and its appendages, constituting the organ of *vision*, merit particular attention. The ball of the eye is encased in a bony cavity, where it is securely lodged, and through the back part of which it communicates with the brain.

In man, and those animals which resemble him, the cavity of the orbit is composed of seven bones, of which the *frontal bone* forms its upper part, or roof, the *upper maxillary* the greater part of its floor, the *sphenoidal* and *malar* its outer sides, and the *ethmoidal* and *ungual* the greater part of its inner side, while the *palatal bone* forms a small portion of its lower part within. In its general form it is conical, having a large opening in front, surrounded with a strong bony ridge, and drawing nearly to a point within. It is lined with *periosteum* and fat.

Round the outer bony circle of the orbits is attached the *orbicular muscle* that forms the fleshy part of the eye-lids, the rest of these curtains being composed of loose skin and cellular membrane, and terminated at their edge by an arched cartilage, called *tarsus*, supporting the eye-lashes, and having a number of minute orifices that form the outlets of minute glands; and not far from the inner corner of the eye are two more remarkable orifices, one in each eye-lid, from which proceed two canals, meeting at the inner corner, and leading to the nose. These form the lacrymal points and ducts that carry off the superabundant tears into the nostrils. That part of the upper eye-lid which supports the eye-brow, is provided with thicker cellular substance; and the inside of each lid is lined with a very fine, soft, and delicate membrane, which, being reflected over the greatest part of the front of the eye-ball, forms what is called the white of the eye.

Sensation.

The eye-ball is composed principally of three or four membranes called *coats*, and three fluids, of more or less density, called *humours*. The outer coat is dense and fibrous, and, being of a firm texture, is called *sclerotic*, or hard coat, and covers about four-fifths of the eye-ball. The remaining fifth, forming a small spherical prominence in front of the ball, is protected by a pretty thick transparent part, closely united at its edge to the sclerotic, and called *cornea*. Within the sclerotic coat is another called *choroid*, composed of numerous convoluted blood-vessels, and lined with a dark opaque mucous matter, called by anatomists *pigmentum nigrum*. Within this again is a very delicate nervous expansion, evidently proceeding from the trunk of the optic nerve, which is considered as the third coat of the eye, and called *retina*.

The interior of the eye-ball may be regarded as composed of three cavities, each lined with a peculiar membrane, and containing fluids of very different densities. By far the greater portion, including all the back part of the ball, is filled with a fluid very much resembling, in colour and consistence, the white of eggs before it is coagulated. This is called the vitreous, or glassy humour. It has a circular concave depression in the middle of its anterior part, in which lies a body of a double convex figure, but flatter on its fore part, and of much greater density than the vitreous humour. It is inclosed in a thin transparent membranous capsule, and, from its form and transparency, is called *crystalline lens*. Its margin is surrounded with a plaited membrane, attached to the vitreous humour, and called *ciliary plicæ*. The remaining part of the eye-ball in front of the lens is filled with a clear watery fluid, thence called the *aqueous humour*; but this cavity is divided into two unequal portions, called the *anterior* and *posterior*, by a broad circular coloured membrane, extremely vascular, called the *iris*, with a central circular opening, capable, in the healthy state of the eye, of contraction and dilatation, called the *pupil*.

If we suppose a line drawn through the centres of the *cornea*, the *pupil*, and the *crystalline lens*, it will form the axis of the eye-ball. Now the part where the trunk of the optic nerve communicates with the eye-ball is not in this axis, but on the side of it next the nose, and its entrance is marked by a small spherical prominence projecting within the eye. Nearly at the posterior extremity of the axis there is a small spot on the choroid coat, of a yellowish colour, and not covered with the expansion from the optic nerve, so that the *retina* appears here to be perforated.

The eye-ball is nearly enclosed in four straight muscles, which, acting separately, move it upwards, downwards, to, or from the nose, but, acting together, press it backwards, and probably flatten it. There is a peculiarity of structure in the course of the *superior oblique muscle* that deserves to be noticed. Its tendon passes through a perforated cartilage, attached to the inner or nasal side of the orbit, and forming a pulley on which the tendon moves, so as to alter materially the direction in which the fibres of the muscle would act were it not for this contrivance; hence this has been called the *trochlear muscle.*

In the upper part of the orbit, between the eye-

Sensation. ball and periosteum, on the temporal side, is a compound glandular body, whose office is to secrete the tears, whence it is called the *lacrymal gland*. From it there pass several tubes through the substance of the upper eye-lid, and opening towards the cornea, and through these the tears continually exude, and are spread over the eye by the motions of the upper lid.

The immediate organ of vision appears to be the *retina*; for when the optic nerve is rendered insensible, as in the disease called *amaurosis*, though every part of the eye-ball is in a sound state, vision is destroyed; and experiment has proved that no sensation of vision is produced on that yellow spot we have mentioned at the bottom of the eye where the *retina* is deficient.

Vision is produced by the rays of light, which, entering the eye through the transparent *cornea*, are variously refracted in passing through the *aqueous humour, crystalline lens*, and *vitreous humour*, and strike upon the *retina*. As the rays of light come from various points of a visible object, and pass in straight lines to the pupil, they must cross each other; and we know that when an eye, taken from the body and properly prepared, by removing the *sclerotic* and *choroid* coats from its back part, is held at a proper distance from a luminous object, a picture of this object in an inverted position appears upon the *retina*. Hence it is natural to conclude, that the picture of visible objects formed by the rays of light on the retina of a living eye, are inverted, though habit and experience enable us to represent them to the mind in their natural position.

There is a certain distance, or *focus*, at which every object is most distinctly seen, but this distance varies in different individuals. Thus, a middle-aged person, with good eyes, can read an ordinary type most distinctly at the distance of about eight inches. A young person, or one that is near-sighted, requires the object to be much nearer the eye, and an old person sees best at a greater distance. The reason of this is, that in the former, at the medium distance, the rays of light are refracted too much, and meet in a point before they reach the *retina*; while in old people, or those who are called far-sighted, the rays are less refracted than usual, and do not meet in a point upon the *retina* unless the distance of the object is increased.

For perfect vision, it is necessary that the cornea, the crystalline lens, and the humours be perfectly clear and transparent, the pupil round, open, and easily susceptible of contraction and dilatation; that the *retina* be sensible to luminous impressions; and, in general, that the mucous pigment that covers the *choroid coat* be of a dark colour.

The great use of this pigment seems to be to absorb the rays of light, and prevent the confusion that would be occasioned by their reflection. This is peculiarly necessary in a strong light. Hence people, in general, whose pigment is black, and whose pupil readily contracts, see most distinctly in a strong light; whereas those who have weak eyes, or whose pupil is less sensible to the stimulus of light, see best when the light is moderate, as in twilight. This is also the case when the centre of the *lens* becomes opaque; for then, as the rays of light can pass only through the margin of the *lens*, it is necessary that the pupil should be considerably dilated before a sufficient number of rays can be admitted, and this in such eyes can happen only in a moderate light. Sensation.

Persons with light hair and light eye-brows and eye-lashes, have generally the pigment of a corresponding light colour; and those persons called Albinos have it of a reddish colour, as is the case with white animals among the inferior classes. None of these can bear a strong light, and the latter see distinctly with a very faint light. This also depends much on habit. Those who have been long shut up in a darkened room or dungeon, can at length distinguish objects which, on their first entering the apartment, were totally invisible.

Some persons, especially when young, have the *cornea* unusually convex, which occasions them to be near-sighted. The opposite infirmity is produced in old people by the flattening of the *cornea*, and the sinking of the eye within the orbit, in consequence of the absorption of some of the fatty matter with which the eye-ball is surrounded. The former defect is generally remedied by *concave*, and the latter by *convex* glasses. The circumstance of our seeing an object single with two eyes, though there is no doubt that an image of the object is painted separately on the retina of each eye, has not yet been satisfactorily explained. It is generally supposed to be the effect of habit; but even persons who have been born blind, and have their sight suddenly restored by a surgical operation, do not see objects double; while any person may, under certain circumstances, make himself see double, though generally accustomed to see in the usual way.

If we except one of the *mammalia*, the blind rat, one reptile, the *proteus*, and one fish, the *myxine glutinosa*, all the vertebral animals with which we are acquainted possess the sense of vision; for even the mole, which has often been represented as blind, has perfect, though very minute eyes. In all these classes, too, the eyes are always two in number, though in one of the inferior orders of insects there are animals which have six or eight eyes.

The eyes of the inferior animals differ much in proportional magnitude. Among quadrupeds, the mole and the shrew have proportionally the smallest eyes; but, in general, the magnitude of the eye-ball is in an inverse ratio to that of the animal. This holds true also in other classes. In the largest whale, measuring sixty or eighty feet in length, the eye-ball is not larger than a middle-sized orange. The eyes of young animals are also proportionally larger than those of the adult.

The eyes also differ in direction. Only the ape tribe have them directed forwards as in man; in all other quadrupeds, in birds, and most reptiles, they look sideways. In some reptiles, and in many fishes, the eyes are situated nearly at the top of the head, so that they are naturally directed upwards.

In general structure the eyes of quadrupeds nearly resemble those of man, except that the *sclerotic coat* is generally thicker and firmer, especially at its back part; that the *choroid coat*, at the bottom of the eye, is, in many instances, especially in those quadrupeds that play by night, of a brilliant colour;

Sensation.

that the *cornea* is often more convex and protuberant; that the *retina* is often evidently fibrous; and that the figure of the *pupil* is frequently of an oblong or oval form. Some quadrupeds, too, have a third eye-lid, or what is called a nictitating membrane, which draws over the *cornea* sideways, and defends the eye either from too much light or from external injury. This membrane is most remarkable in the cat tribe, the opossum, the seal, and the elephant. Few quadrupeds have eye-lashes.

The eye of cetaceous animals has the back part of the *sclerotic coat* thick and cartilaginous, while its fore part is thin and soft, and their *crystalline lens* is much more convex than that of man and quadrupeds.

The eyes of birds are generally very large, and lodged in ample, but usually shallow orbits. The *cornea* is very convex, and where it joins the *sclerotic* there is a bony ring formed of plates lying over each other. There is a peculiar organ in these animals called *marsupium*, or the purse, which passes through the *vitreous humour* from the *retina* nearly to the *crystalline lens*. It is an angular membrane, very vascular, and covered with a dark substance like the *black pigment*, and seems intended for absorbing superabundant rays of light. In birds, the lower eye-lid is larger than the upper; and in almost all of this class, the eyes are closed by raising the former. They have also a large nictitating membrane, moved by two peculiar muscles.

In reptiles, the eye is constructed much like that of birds, having a similar bony ring round the margin of the *sclerotic coat* in many of the species, and in general a nictitating membrane. Many of them, however, have no eye-lids, but only a transparent, immoveable curtain formed from the cuticle. This also is the case with serpents.

The eyes of fishes differ from those of other animals, in having the *crystalline lens* of a spherical figure, the *choroid coat* and *retina* composed of several *laminæ*, and in having a firm body, shaped like a horse-shoe, between the internal and middle layers of the *choroid*. There is also a membrane somewhat similar to the *marsupium* of birds.

Among the crustaceous animals there are several that have but one eye, but most of them have two, which, in some instances, are sessile, or close to the body, while in others they are *pedunculated*, or raised on a moveable footstalk.

Of the *mollusca*, only the cuttle-fish, under which we include the *sepia* and *octopus* tribes, and the snails and slugs, have proper eyes, which in the latter tribes are situated on footstalks.

Most insects have eyes, and of these the *arachnides*, or spiders, and similar animals, have from two to eight; while in some other insects, as the dragonfly, the exterior of the eye is composed of a vast number of small six-sided convex surfaces, each of which seems to perform the office of an eye.

Sect. III. *Of the Internal Senses and of Sleep.*

Certain affections of the mind, which seem to depend on the action of the brain, as *memory*, *imagination*, *judgment*, have been called the *internal senses*. Although the consideration of these belongs properly to metaphysics, it may be expected that we should briefly notice them here.

Of the internal senses, *memory* is the most general among animals, and that which appears to be the soonest developed. A very considerable number of the inferior animals enjoy this faculty in common with man, and many of them apparently in an equal degree. The *dog*, the *horse*, and the *elephant*, are instances familiar to every one; and indeed all those animals that are susceptible of domestication show evident proofs of memory. The *parrot* remembers the lessons he is taught; the *canary bird* whistles correctly the tune he has acquired; the *tortoise* hobbles to meet the hand that is accustomed to feed it; and even the *toad* resorts to the spot where it receives its daily food. It is probable that in most animals memory is confined to what has been called *reminiscence*, or the *passive remembrance* of past events, though man is not the only animal capable of *recollection*, or the faculty of *recalling former ideas and perceptions*. When the dog, after an absence of some months or years, sees a person with whom he was formerly intimately acquainted, he usually looks and smells for some time before he recognises his former friend; and when he is satisfied of his identity, suddenly breaks out into rapturous expressions of joy at his return. In this case we think he exhibits proofs of *recollection*; and such proofs are occasionally exhibited by some other of the nobler quadrupeds.

The faculty of memory, as far as respects *susceptibility*, is strongest in childhood; but the mind is more *retentive* in youth and manhood. As age increases, the susceptibility of the memory declines; and an old man, who can readily remember the transactions of his boyish days, often finds it difficult to recollect the occurrences of yesterday.

Memory evidently depends much on the state of the body, and particularly on that of the nervous system. A fever, or a stroke of apoplexy, terminating in palsy, sometimes completely oversets the memory, and erases from the mind all traces of former ideas. A fit of intoxication has the same effect as to the events that took place during this temporary derangement of the mental powers.

Imagination, as far as we can conceive, is confined to *man*; though it differs in degree or vivacity in different individuals of the human species. It is generally most lively in youth; being not yet formed in early childhood, and subsiding with the advance of age. It does not seem to depend so much as memory on the state of the body, except that, in certain diseases, it becomes more lively, in others more or less depraved.

The faculty of *judgment*, as it depends on the exercise of reason, is certainly most remarkable in the human species; but is, we are satisfied, by no means the exclusive privilege of man. That *dogs*, *elephants*, *horses*, *cats*, compare, discriminate, and judge, cannot be doubted by those who have studied the natural history of those animals.

Unlike the two former faculties, judgment increases with age, at least till that period of dotage arrives when all the human faculties begin to sink into oblivion. This faculty never varies with the state of the body. In some diseases it is depraved,

Sensation.

in others nearly destroyed. Indeed, it is intimately connected with memory, and of course undergoes corresponding changes.

As connected with the nervous system, physiologists have also considered the *passions*. These, in a physiological point of view, are divided into the *exciting* and *depressing*. Of the former, the most remarkable are *hope*, *joy*, *love*, *desire*, *anger*, and *rage*; of the latter, *envy*, *jealousy*, *fear*, *grief*, *terror*. The exciting passions quicken the circulation and respiration, increase the animal heat, propel the blood to the head, and, when in an extreme degree, produce phrenzy, apoplexy, or death. The depressing passions act more on the nervous than the circulating system, though some of them, too, quicken the circulation. In their highest degree, especially when acting suddenly, they induce fainting, palsy, or death, from a sudden cessation of the motion of the heart.

Sleep forms another subject connected with the physiology of the nervous system, and is generally regarded as an affection of the mind.

The alternate states of watchfulness and sleep seem necessary in the economy of all animals; but the degree and manner of repose by sleep are very different. Some animals, as *reptiles*, and a few *quadrupeds*, appear to pass the greater part of their lives in a state of sleep, or torpor resembling sleep, while many of the human species scarcely occupy a fourth part of their time in this state of inactivity. The degree of sleep, however, depends much on age and habit. The younger the animal, the more sleep is necessary; and those who pass a life of indolence, sleep much more than the active and laborious.

The darkness of night, as it naturally invites to sleep, by withdrawing the objects of the senses, forms the natural season of repose to most animals. Some, however, as beasts and birds of prey, are most watchful during this period, which they employ in hunting.

The *attitude* in which animals sleep is also different. Many of them lie in a recumbent posture, as *man* and *quadrupeds*; some sit perched on a twig, or similar object, as most birds; others of the feathered tribes sleep standing on one leg; a few, as *bats*, hang suspended by the hind legs; and several fishes, and other marine animals, lie motionless on the surface of the water.

During sleep the voluntary animal powers are suspended, and the senses lie inactive, though some of them, as hearing particularly, are capable of being excited without banishing sleep. The *involuntary* actions, as circulation and respiration, are continued, but are slower than in the waking state. The imagination too, is generally very active, as appears from *dreaming*.

The immediate *cause* of sleep is supposed to be the exhaustion of what different physiologists call the *irritability*, *excitability*, or *sensorial power* of the system. It is evidently connected with a diminution of the *nervous energy*.

The subject of *dreams* being rather *metaphysical* than *physiological*, belongs to a different subject; but that of *torpidity* we shall consider after describing the phenomena of *respiration*.

Digestion.

Chap. III. Of Digestion.

Nature points out to all animals the necessity of repairing the waste of the body that is constantly going on by the appetites of *hunger* and *thirst*. There are indeed many animals, especially among the reptiles, that can endure abstinence for days, weeks, or even years, (see Abstinence;) and one among quadrupeds, the camel, can travel for several days without a fresh supply of drink; but all these animals bow at length to nature's laws, and perish if the supply of food or drink be too long delayed. There is perhaps no animal that bears hunger and thirst less easily than man; but man is the creature of habit, on which these appetites materially depend.

The younger the animal, the more frequent and imperious are the calls for food. This is evidently owing to the growth of parts, and the progressive evolution of the whole body, which is continually going on during the early stages of life. When the body has acquired its full growth the demands for nourishment are less urgent; and as age increases, both the appetite for food and the power of digestion generally diminish.

As all animals do not live on the same kinds of food, they are divided into three classes, according to the nature of their aliment. Those which live entirely on vegetable food are called *herbivorous animals*; those whose diet consists entirely of animal substance *carnivorous*; and such as feed equally or indifferently on both are denominated *omnivorous*. Perhaps man is the only animal that is naturally omnivorous, though many animals may be compelled by hunger, or taught by habit, to subsist on food to which their digestive organs are not naturally adapted.

Stages of digestion.—The general function of digestion consists of several stages. In the vertebral animals the food is first received into a mouth, where, in some cases, it is chewed or *masticated* by means of teeth, and mixed with *saliva*, while in others it is swallowed whole. From the mouth it passes through the gullet, by the act of deglutition, whence it is received into a stomach where it undergoes solution, and forms a crude mixture called *chyme*. This being received into the small intestines, and mixed with other fluids, forms *chyle*, which is gradually taken up or *absorbed* in the manner to be afterwards explained, while the superfluous, noxious, or excrementitious part is carried off by the large intestines, and finally expelled. Hence we divide digestion into *mastication*, *insalivation*, *deglutition*, and *chylification*.

Sect. I. *Of Mastication and Insalivation.*

The *organs* subservient to these stages of digestion are, the mouth, with its contained organs, the teeth, and tongue.

Mouth.—The cavity of the mouth is composed partly of hard and partly of soft parts. The hard parts are the jaws or *mandibles*, the *palate*, and the teeth, where these are to be found. The soft parts are the lips and cheeks externally, and the soft palate and gums within. The jaws and palate have already been described.

Variety of teeth.—Many animals are without teeth. This is the case with *ant-eaters*, *manes*, *armadillos*, and the *duck-billed animal* among quadrupeds; with the *balenæ*, or proper whales, among cetaceous animals; with all birds; with tortoises among reptiles; and with most invertebral animals. The teeth vary considerably in number, figure, and proportion, in the different tribes and classes of animals, but, in general, may be divided into three classes, *cutting teeth*, *tearing teeth*, and *grinding teeth*. The first are more or less flat and wedge-shaped, terminating with a cutting edge; the second are more or less conical, pointed at the tip, and often curved; and the third are broad and thick, generally terminating in several pointed protuberances, or a broad unequal surface. Some animals have only the second kind, and some only the first and third, and others only the second and third; only a few have them of all the three classes. This is the case with man and those quadrupeds which resemble him.

Structure of the teeth.—The teeth are generally composed of two parts, a body, and fangs or roots; the body being that which projects without the jaw, and the fangs those parts by which the tooth is fixed in its socket. The *cutting*, and generally the *tearing* teeth, have but one fang, but the grinders have several. In their intimate texture the teeth are formed of two substances, differing from each other in colour and consistence. The fangs, and part of the body of the tooth, are composed of bones similar to that which forms the skeleton; the rest of the body is formed of an extremely hard brittle white and shining substance, called *enamel*, which in some cases covers the tooth like an external shell, in others is intermixed with the bony part of the body of the tooth. The teeth are provided with blood-vessels, and probably with nerves, which pass through tubular hollows in the fangs.

An animal has not the same number of teeth in every period of its life. A certain number, called *temporary* teeth, make their appearance some time after birth; these are shed, and are succeeded by a greater number, which continue permanent.

In man there are twenty temporary teeth, which usually begin to make their appearance about seven or eight months after birth. They generally appear in the following order. Two of the front teeth in the lower jaw are first cut, and are soon followed by two in the upper jaw, and so on till the eight cutting teeth are produced. Then two of the *grinders* next the front are cut in each jaw, and after these the pointed teeth called *dog-teeth*, and in the upper jaw *eye-teeth*. These are followed by the rest of the grinders, till all the temporary teeth are produced, which generally happens within three years after birth. When the child is about six or seven years of age it begins to shed the temporary teeth, to make room for the permanent teeth, which are cut in much the same order as the former. They are generally 32 in number, and consist of eight front, or cutting teeth, four *canine*, or eye-teeth, four *bicuspidated*, or first grinders, and sixteen other grinders, the latest of which are sometimes called *wisdom-teeth*, as they seldom make their appearance till about the age of puberty.

Teeth of quadrupeds.—Of those quadrupeds that have teeth, the apes, lemurs, and bats nearly resemble man in their number and proportions. Those constituting part of Linnæus' *second order*, as the sloths, rhinoceroses, and elephants, have no cutting teeth in either jaw, while in the order *Feræ*, including most of the beasts of prey, there are numerous front teeth, but they are rather tearing than cutting teeth. The *glires*, comprehending, among others, porcupines, beavers, rats, and mice, marmots, hares, and rabbits, have two long and strong cutting teeth in each jaw, and a few grinders in the back part of the mouth, with large intervening spaces. The ruminating animals, including camels, sheep, deer, antelopes, goats, and horned cattle, have cutting teeth only in the lower jaw; while of the last order, *belluæ*, all have cutting teeth in the both jaws; and some, as the hog tribe and river horse, have the *canine* teeth prolonged into formidable tusks.

Of cetaceous animals.—The cetaceous animals that have teeth are chiefly the *cachalots*, or spermaceti whales, which have teeth only in the lower jaw, and the dolphin, porpus, and grampus, which have teeth in both jaws, all generally of the pointed tearing kind; but those called unicorn fish have a very long taper tusk (sometimes two) standing out from the muzzle. The proper whales have those peculiar horny plates, terminating in a hairy margin, improperly called whale-bone, which, though they answer not the purpose of mastication, serve to retain the food taken into the mouth.

Of birds.—Though birds have no teeth, many of them employ their mandibles for cracking seeds, &c. or for perforating the bark of trees in search of insects.

Of reptiles.—Among the reptiles all those called *sauriens*, comprehending lizards and similar tribes, have pointed cutting teeth in each jaw, and some have them in the palate. Frogs have teeth only in the upper jaw, salamanders in both, while toads have them only in the palate. Serpents have generally numerous sharp-pointed teeth in both jaws; and those which are venomous have sharp curved tusks in the upper jaw, that are perforated with a tubular canal, and connected with a bag containing a poisonous fluid, which, when pressed on by the tooth, suffers the poison to flow down through the tubular opening into the wound inflicted by the animal.

Of fishes.—The teeth of fishes are usually small but very sharp; but some of the larger tribes, as the shark, have them of a very formidable size and number, and attached to the palate as well as the jaws.

Crabs, &c.—Of the invertebral animals that have teeth, the principal are crabs, lobsters, sea-mice, leeches, sea-urchins, and star-fish.

Gums.—The gums are rather membranous than fleshy. They are very vascular, but, having few nerves, possess little sensibility. They serve to strengthen and support the teeth.

Cheeks, &c.—The cheeks and lips are most remarkable in man and those quadrupeds which resemble him, though they are found to a greater or less extent in almost all the animals that have teeth. They are formed partly of what is called the common integuments, that is, the skin and contiguous membranes, partly of the muscles formerly enumerated, and partly of a mucous membrane that lines the whole cavity of the mouth. Through the substance of the cheeks there passes on each side a pipe from the parotid glands, pouring the saliva into the mouth.

Mastication.—Only man and quadrupeds can properly be said to masticate. The toothed cetacea, reptiles, serpents, and fishes, appear to swallow their food whole, and their teeth are evidently formed rather for seizing and retaining their prey than for chewing it. Many of these latter tribes, however, particularly serpents, employ the process of insalivation, licking their prey all over before proceeding to swallow it.

Many *crustaceous* animals are furnished with jaws and other organs, either for breaking down their food or cutting off substances for which they have occasion. Thus, crabs and lobsters, besides the proper jaws, have the two large claws toothed and furnished with very strong muscles, by which they are enabled to break the shells of the testaceous mollusca on which they feed, and wasps are able to cut off pieces of flesh for their food, or particles of wood for constructing the cells in which they live, by means of their jaws. Some insects have several pairs of jaws, but in general there are only two pairs which move laterally. The larvæ, or caterpillars of insects, have also jaws with which they bite the vegetables that constitute their food.

Mastication is performed chiefly by the lateral motions of the jaws, by which the food is ground between the teeth, while it is mixed with saliva, and thus rendered more soluble in the juices of the stomach.

Rumination.—The process of rumination, which takes place in Linnæus' order *Pecora*, and a few other animals, is a sort of second mastication; the food, after being received into one of the stomachs, being partially disgorged and chewed again before passing into another cavity where it is to undergo a more perfect digestion.

In some animals, there are certain cavities where the food is laid up for a time before being finally swallowed, and where, probably, it undergoes a partial insalivation. Such are the cheeks, pouches of some apes and rats, and the *crops* of granivorous birds.

Sect. II. *Of Deglutition.*

The organs employed in deglutition are chiefly the *pharynx*, the gullet, and the tongue, of which the last has been already described.

Pharynx.—The pharynx is that opening which is seen at the back of the tongue. Its figure is nearly that of a funnel, being expanded above where it is connected with the sphenoidal bone and bone of the tongue, and growing narrower below where it terminates in the gullet. It is partly membranous and partly muscular, and the membrane that lines its inner surface is of a pretty deep red colour.

Gullet.—The gullet in man is a tube of considerable length, partly membranous, but furnished with numerous fleshy fibres. When distended it appears cylindrical, but in its usual state of collapse it is rather flat. It extends from the termination of the *pharynx* in the upper part of the neck, through the rest of the neck, and through the chest, close beside the vertebræ, but not exactly in a straight direction, till it enters the stomach. Though very small in its inactive state, it is susceptible of considerable dilatation, except at its lower extremity.

In quadrupeds.—Only the *vertebral animals* have a gullet distinct from the stomach; and its differences in the several classes are not very remarkable. Among the quadrupeds these differences consist chiefly in the greater or less muscularity of this tube, being most muscular in *herbivorous* animals, and most membranous and dilatable in the *carnivorous*. The muscular fibres run downwards in a spiral direction, crossing each other.

In cetaceous animals.—The gullet of cetaceous animals has a peculiarity of structure, consisting of a fleshy tube extending from its upper part to the internal opening of the nostrils or blowing holes, furnished with circular fibres, which, contracting during the act of swallowing, interrupt the communication which would otherwise subsist between the pharynx and the nostrils.

In birds.—The gullet of birds is sometimes of considerable size, especially in those which feed on fish. The crop of birds is merely an expanded portion from the lower part of the gullet, and forms a bag in front of this tube, and out of the natural direction of its cavity.

In reptiles, &c.—In most reptiles the gullet is larger in proportion to the stomach than in quadrupeds, and has numerous longitudinal folds which render it susceptible of considerable dilatation. In tortoises and turtles, its inner surface projects into numerous conical processes directed towards the stomach, evidently intended to prevent the return of the food. The gullet of serpents is remarkable for its great length and extreme dilatability, so that these animals can swallow a substance of greater diameter than that of their own body. The gullet of fishes is very short, but proportionally wide.

Deglutition.—The act of deglutition requires but little explanation. The food being thrown back by the tongue is received into the *pharynx*, whence, partly by its weight, and partly by the muscles attached to the pharynx, it descends to the gullet, along which it is propelled chiefly by the muscular action of this tube, assisted, in some cases, by the neighbouring muscles of the neck.

Sect. III. *Of Chylification.*

The stomach.—This organ is the only part of the intestinal canal which is found in all animals, but perhaps there is no organ which presents greater varieties. In most animals it is a single cavity; but, in many, it is either composed of several cavities, or divided into several compartments.

In man.—The stomach of man, in figure, has been compared to the bag of a bagpipe. It is largest at the extremity next the gullet, smaller at the opposite extremity, and is distinguishable into two compartments by a constricted portion nearly in the middle. The orifice by which it communicates with the gullet is called *cardia*, and is at some distance from the broad extremity. The other orifice by which it communicates with the bowels, and which is exactly at the small end, is called *pylorus*. Hence

Digestion. the two compartments of the stomach have been termed its *cardiac* and *pyloric portions*, of which the former is at least twice the size of the latter. The stomach is said to have two curvatures, a smaller extending from the root of the gullet to the *pylorus*, next the vertebral canal, and a larger on the opposite side, which, when the stomach is empty, is directed downwards, and when the stomach is distended is turned forwards. The stomach is situated in the upper part of the belly, but nearer the left than the right side, occupying great part of what from it is called the *epigastric region*. It is composed of three principal layers; a *peritoneal coat*, derived from the common lining of the belly; an internal *villous* coat, forming part of the mucous membrane that lines the whole intestinal canal; and a thin muscular coat, most evident next the pylorus, and lying between the other two. The stomach is provided with several large arteries, numerous branches of nerves, and mucous glands. It is attached to the neighbouring parts by doublings of the peritoneum, and has hanging from its large curvature a fatty membrane extending over the bowels, and called *omentum* or caul.

The division of the stomach into *cardiac* and *pyloric* portions is most evident after taking food, when the constriction is generally so great as, for a time, to prevent the food from escaping out of the *cardiac* into the *pyloric* portion.

Gastric juice.—There is a fluid formed within the stomach, different from the mucus, which naturally moistens the inside of the whole alimentary canal. It is limpid, and possesses no very sensible properties, and yet it has considerable solvent powers. This is called the *gastric juice*.

Intestines.—The remaining and longest part of the alimentary canal, called the *intestines* or bowels, is, by anatomists, divided into two primary and six subordinate portions. Taken as a whole, it is divided into *small* and *large* intestines, and each of these are subdivided into three parts. That portion of the small intestines which extends for about twelve inches from the *pylorus*, is denominated *duodenum*. It passes obliquely across the vertebræ towards the right, and is of larger diameter than the rest of the small intestines. It takes several turns, and in the posterior part of what is called its third flexure it is perforated obliquely by the biliary ducts coming from the liver and gall-bladder.

The rest of the small intestiues, which anatomists have chosen to distinguish into *jejunum* and *ileum*, occupy the greater part of the lower belly, where they make numerous turnings or convolutions. Towards the fore part and sides of the belly they float loose, but towards the back they are secured together and fastened to the vertebræ by an extensive plaited membrane called *mesentery*.

The large intestines commence in the right side of the belly, by a portion of considerable diameter, called *cœcum*, into which the small intestines open by a projecting part which acts imperfectly as a valve. The *cœcum* forms a bag of nearly a cubical form. From this bag to within about a foot of the termination of the bowels, the intestinal canal takes the name of *colon*. This portion commencing, on the right side of the belly, makes a turn upwards, and then crosses the belly immediately below the stomach, to the left side, where it makes two short turns so as to form a figure resembling the letter S, and then terminates in the rectum or straight intestine.

This last is situated chiefly in the hollow of the *sacrum* and *coccyx*, and grows larger as it descends till it terminates in the *anus* or fundament. At this exterior opening there are several muscles which act chiefly either in compressing the sides of the bowel; thus promoting its evacuation, or in contracting its outer extremity, and thus preventing the involuntary escape of its contents.

The intimate structure of the whole intestinal canal resembles that of the gullet and stomach, but the internal folds of its villous coat are more remarkable, especially in the small intestines, where they form numerous projections internally, and thus increase the interior surface of the bowels. The colon, too, in consequence of three sets of longitudinal muscular fibres, is contracted into numerous compartments or cells, which are most remarkable in the transverse arch and flexures on the left side.

Chylification.—The process of chylification appears to take place in the following manner: The food having entered the stomach, is dissolved, or reduced to a pulp, chiefly by the chemical agency of the *gastric juice*, and partly by the mechanical pressure of the stomach. This process appears to take place in the *cardiac* portion; and when it is sufficiently completed, the stricture between this and the *pyloric* portion is gradually relaxed, and the aliment, now become *chyme*, or imperfect chyle, passes into the latter portion, where it is probably mixed with a portion of bile passing upwards. Hence it is propelled by the muscular action of the pyloric portion through the *pylorus* into the *duodenum*, where it is mixed with the bile coming from the liver, and with a fluid resembling saliva, coming by another pipe from an organ called the *pancreas*, (to be hereafter described) and called the pancreatic *juice*. In this way probably is formed the perfect chyle, which is a fluid resembling milk.

The chyle, together with the superfluous or excrementitious part of the aliment, now proceeds forward through the convolutions of the small intestines, by what is called the *peristaltic* motion, which is the effect of the contracting power of their muscular coat, excited to action by the stimulus of their contents, and especially by the bile. In the progress of the aliment through the small intestines, in the healthy state of the body, the greater part of the chyle is gradually absorbed by innumerable small vessels opening internally among the folds of the villous coat, while the rest is gradually propelled into the *cœcum*. Here it probably undergoes a farther change, and hence it passes through the *colon*, where it appears to lose its remaining nutritious particles; and when it reaches the rectum it becomes mere excrementitious matter.

The comparative anatomy of the intestinal canal is of importance both to the naturalist and physiologist; and it is chiefly from it that several valuable facts respecting this function have been derived. We find that the length and complex structure of this canal depend much on the nature of the aliment employed.

In *carnivorous* animals the whole canal is in general proportionally short, and the stomach simple; whereas in those animals that live on vegetable food, the intestines are remarkably long, and the stomach is often of a very compound structure.

Stomach of quadrupeds.—The stomachs of quadrupeds, in their general structure, resemble that of man, except that their muscular coat is generally stronger and more evidently fibrous; and that in several instances, as in the hare, rabbit, horse, and ass, the division into *cardiac* and *pyloric* portions is very manifest and permanent. The stomachs of apes, bats, and lemurs, nearly resemble that of man in figure, except that of bats, which is rounder.

Ruminating animals.—It is chiefly among the ruminating quadrupeds that the stomach is formed into several separate cavities, though this compound structure is not confined to that order. Thus, the hamster-rat has two distinct cavities, the kangaroo three, and the sloth four. The structure of the stomachs of ruminating quadrupeds, as exemplified in the cow and sheep, is nearly as follows: The first stomach, or *paunch*, is the largest in the adult animal, and has its internal coat beset with numerous flattened *papillæ.* The second stomach is called *honeycomb bag*, vulgarly *king's hood*, and is considerably smaller than the former, from which it differs chiefly in the elegant cellular appearance of its internal membrane. The third cavity, called the *many-plies*, from the numerous folds of its internal coat, is the smallest of the four; and these three are connected in such a manner, that, under different circumstances, the food can pass from the gullet, either into the first stomach only, or the third only, without entering either of the others, in the first instance. The fourth stomach, commonly called the *red*, is nearly as large as the first, is shaped somewhat like a pear, and its internal coat is longitudinally wrinkled.

Camel.—In addition to this general structure, the camel tribe have numerous cells formed in the substance of their first and second stomachs, capable of being closed or opened at pleasure, and it is in these cells that the animals deposit the store of water which serves to quench their thirst when traversing the burning sands of the desert.

Cetaceous animals.—*The stomachs of cetaceous animals* is generally compound, and resembles in structure the stomachs of ruminating quadrupeds. This is the more remarkable, as these animals appear to live entirely on *fish, mollusca,* young seals, or the smaller species of their own tribes.

Both in quadrupeds and cetaceous animals the distinction between the small and large intestines is very general; but their proportional length differs very much, the large intestines being usually longest in the graminivorous quadrupeds. Many of the quadrupeds have no *cæcum.* In the cetacea, the folds of the villous coat are most remarkable, and the whole canal appears divided into cells.

Birds.—The stomachs of birds also differ in structure, according to the nature of their aliment. In those that feed on insects and smaller birds, the principal part of the stomach is a thin membranous bag; whereas in *granivorous* birds the stomach consists principally of two very thick and fleshy hemispherical portions, connected by a strong membrane, and lined with a thick horny internal coat, constituting what is generally called the *gizzard.*

The intestines of birds are proportionally longer in those that are *granivorous,* though even in them much shorter in proportion than in quadrupeds, and the distinction into small and large is very obscure. The intestines in these animals open below into a cavity, which forms a common outlet to the excrements and eggs in the female.

Reptiles, &c.—In reptiles and serpents the stomach is generally simple, though sometimes it is divided into two compartments. Its figure is extremely various, being globular in the crocodile, oval in the guana, pear-shaped in the flying dragon, and in most of the other tribes forming a long cylindrical tube but little distinguished from the gullet or intestines. The intestinal canal of these animals is generally very short, resembles that of birds, and terminates below in a similar manner.

Fishes.—In fishes the stomach is usually small, thin, and membranous, but in a few instances its sides are thick and fleshy, bearing a distant resemblance to that of birds. Their intestinal canal is also short and very uniform in its structure.

Among the mollusca, one species of *helix,* has a muscular stomach, and the *laplysiæ,* or sea-hares, have three of these, with bony processes within. Their intestines are short, but generally a little convoluted.

Crustaceous animals.—The stomach of some crustaceous animals, as the crab and lobster, consists of a membranous bag, supported by a long frame, and having at its farthest outlet those hard parts that are called teeth. There is a very short straight intestine.

Insects.—The stomach of insects is generally simple and membranous; but the intestinal canal of the locust is very complicated, and connected both with a membranous and muscular stomach.

Polypes.—Polypes may be said to be all stomach, being formed almost entirely of a membranous tube, open at one extremity, into which their prey is conveyed by numerous arms, and by which, after sufficient solution in the cavity, the undigested portion is thrown out.

There are certain organs in the neighbourhood of the stomach which appear in a greater or less degree to assist in digestion, and are therefore sometimes described among the digestive organs. These are, the *liver,* the *spleen,* and the *pancreas,* which will be considered under the organs of *Secretion.*

Chap. IV. Of Circulation and Absorption.

The circulating and absorbent systems are intimately connected. By the latter the chyle is taken up from the intestines and fluids, and decayed or noxious parts of the body are removed from situations where they might do injury, and conveyed into the general mass of fluids, the former to be distributed by the general circulating system to every part of the body, and the latter to be thrown out by peculiar channels connected with the circulating system. Hence it will be of advantage to consider them under the same chapter, though the organs of circulation must first be described before those of absorption can be properly understood.

Sect. I. *Of Circulation.*

The organs of circulation in the more perfect animals consist of the *heart*, the *arteries*, and the *veins*, and, connected with these, certain vessels called *exhalants*.

The *heart* is the centre of the circulating system. Taken as a whole, it is generally of an oval form, largest at one end, and consists of several cavities, with strong fleshy sides.

The heart of man is to be regarded as a double organ, being composed of two sets of cavities connected each with appropriate vessels; and, to understand its structure, it will be necessary to make a few observations on the nature and uses of the blood.

The vessels of the human body, as well as those of quadrupeds, cetaceous animals, and birds, contain two kinds of blood, one of a florid red, the other of a dark crimson colour. The former is that which is fitted for the nourishment of the system, is conveyed to the different parts of the body by the arteries, and is therefore distinguished by the name of *arterial* blood. The crimson blood is that which has already been distributed to the system, has lost, in some measure, its nutritious properties, and circulates through the lungs for the purpose of regaining what it had lost in its former progress through the body. This blood, which is carried back to the heart by the veins, is therefore called *venous* blood. The cavities and vessels on the right side of the heart are always found to contain the crimson or venous blood, and those on the left side the florid or arterial blood.

The human heart lies in the fore and lower part of the chest towards the left side, with its small end or *point* nearly opposite to the sixth rib, and its large extremity or *base* a little raised. It rests on one side upon that muscular membrane that forms the floor of the chest and divides it from the belly. From its relative position, the heart is divided into the right and left side.

The right *ventricle*, which forms nearly one half of the body of the heart, is a triangular cavity, extending nearly to its point, provided with thick, fleshy sides, and having its internal surface rendered irregular by numerous bundles of fleshy fibres, some of which are loose at one extremity, and are connected with tendinous parts, so fixed towards the base of the heart, that when the cavity is full, and the fleshy bundles are thrown into action, the blood is prevented from leaving the ventricle in that direction. Near the base of the heart, at the upper and back part of the right ventricle, is an orifice leading to a large vessel that conveys the blood from the ventricle to the lungs. This orifice is the mouth of the pulmonic artery, and is provided with three membranes, that are concave towards the ventricle, and convex towards the artery, and are constructed in such a manner, that when blood is passing from the ventricle into the artery, they lie close to the side of the latter; but when the artery has received its blood, they converge and form a *valve* that prevents the return of the blood into the ventricle.

Immediately connected with the right ventricle is a cavity with thinner sides, part of which hangs loose from the base of the heart towards the right and fore part; this is the right *auricle*. It is an irregular cavity, with numerous openings, especially two coming from large vessels, the one from the upper and the other from the lower parts of the body, called the superior and inferior *vena cava*, which, by their meeting, form a hollow with thinner sides than the rest of the auricle, and denominated *sinus*. The inside of this sinus is smooth, but has some remarkable folds; the inside of the rest of the auricle is rendered irregular by muscular fibres. Where the right auricle joins the right ventricle, there is an opening, about an inch wide, which admits the blood to pass from the auricle to the ventricle, but is so guarded by the apparatus already noticed as to prevent its return.

The left side of the heart is formed in a similar manner of a ventricle, auricle, and sinus, connected with the aorta and pulmonic veins. The left ventricle is longer than the right, and has thicker sides. It is joined to the right by a fleshy part common to both, and acting as a partition between them. At the upper part of its base is an opening leading to the great trunk of the aorta, guarded, like that of the right ventricle, with three membranous valves, and an opening communicating with the next cavity, capable of being closed by fleshy and tendinous fibres, as in the other side of the heart.

The left *auricle* is joined to the right by a partition, which, in the adult state, is impervious. The sinus of this auricle is larger than that of the right auricle, and has more openings communicating with it, in particular four orifices of the pulmonic veins that bring the blood from the lungs. The communication between this auricle and its corresponding ventricle differs from that between the right cavities in having its valve formed of two principal portions, instead of three, as on the other side.

The heart is inclosed in a pretty strong membranous bag, called pericardium, doublings from which pass over the great trunks of blood-vessels, and immediately and closely invest the external surface of the heart.

The arteries proceeding from the heart form two large trunks, from which many principal branches and innumerable lesser ramifications are sent off. Those of the pulmonic artery, which have received no particular names, distribute the blood through the lungs, not for the nourishment of these organs, but for a purpose already hinted at, and to be more fully explained in the following chapter.

The large artery called *aorta*, is the most important, and above a hundred of its ramifications have been distinguished by names. It will be necessary only to enumerate the larger branches and the parts to which they are principally sent.

The *aorta* rises a little upwards from the left ventricle, but soon makes a turn or arch, after which it proceeds downwards to pass through the belly. While yet in the chest, it gives off two *coronary ar-*

teries to the substance of the heart; and from the arch rise three principal branches, one on the right and two on the left. The branch on the right soon divides into two, of which one passes to the right shoulder and arm, and is named *right subclavian*, or *right brachial*, while the other, called the *right carotid*, rises up the neck to the head. The two branches on the left are the left *subclavian* and the left *carotid*. When the *subclavians* reach the arm, each is, at some point between the shoulder and the elbow, divided into two or three branches, of which the principal are, the *radial*, that passes down the fore arm beside the radius, and is felt beating at the wrist, and the *ulnar* on the opposite side.

When the *carotids* reach the top of the neck, they are subdivided into external and internal. The former supply the neck, jaws, head, and face, by eight principal ramifications; and the latter enter the skull at its base, to supply the brain and its appendages.

The *subclavians* also give off several branches to supply the lower part of the neck, the external and internal sides of the chest, and one material branch called *vertebral*, which passes upwards through the lateral holes in the vertebræ of the neck to the brain.

The *aorta* having entered the belly, gives off the the *hepatic* artery to the *liver*, the *splenic* artery to the *spleen*, the *coronary* arteries to the *stomach*, and as it passes downwards beside the spine towards the left side it gives off the *superior* and *inferior mesenteric* to the *mesentery* and the bowels, the *renal* to the kidneys, and the *lumbar* to the loins and sides of the belly.

When the trunk of the *aorta* has reached nearly the last vertebra of the loins, it divides into two common *iliac* arteries, which, like the *carotid*, are soon subdivided into external and internal; the latter supplying the contents of the *pelvis*, the former passing to the thigh and leg, and receiving, according to its situation, the names of *femoral* in the *thigh*, *popliteal* in the *ham*, and *tibial*, &c. in the leg.

Structure of the arteries.—The arteries, in their general structure, are cylindrical tubes, formed of strong membranes, interspersed with muscular fibres. Their cavities are not interrupted by membranes projecting inwards; and in the living body they have a pulsatory motion perceptible to the touch, and constituting what is called the pulse. In consequence of this innate contractile power, they propel the blood which they receive toward their extreme branches, and here they terminate in very minute tubes, called capillary vessels. They give off their branches at angles more or less acute, and several of these branches communicate together by what is called *inosculation* or *anastomosis*.

Pulsation.—The pulsation of the arteries, or the pulse, varies in frequency and strength at different ages and in different individuals. Its frequency is estimated by the number of pulsations that take place in a minute; and it is found, that in a healthy, middle-aged man, these are about seventy. In women the pulse is generally more frequent than in men, and weaker; its frequency is greatest in infancy and childhood, and least in old age, when it often falls below fifty in a minute.

Veins.—Where the *capillary* arteries terminate, the *veins* begin. These are elastic tubes; but except in the larger trunks they appear to possess no muscularity. They are distinguished from the arteries by their want of pulsation, and by having their cavities interrupted by numerous membranous valves projecting within them, and preventing the passage of the blood from trunks to branches, while they permit it to flow in the opposite direction. The veins are more numerous than the arteries, each trunk of the latter being generally accompanied by two of the former. They are also more superficial. The arteries, in general, lie close to the bones, or deep among the muscles; but besides the veins that accompany these deep-seated arteries, there are many others that appear near the surface, just below the skin, especially on the extremities and the neck, where they are evident in most people by their blue colour, and become still more visible when pressure is made on them. In this case, as the blood flows from the smaller to the larger parts of the veins, that part beyond the ligature, or farthest from the heart, becomes distended in consequence of the interrupted flow of blood.

A considerable number of the principal veins have received names which, in general, are similar to those of the arteries. The most important are the following: The *pulmonic* veins bringing the blood from the lungs; the *ascending* and *descending vena cava*, the former chiefly in the belly, or on the right side of the *aorta*, the latter in the chest; the *jugular* veins in the neck; the *basilic* and *cephalic* in the arm; the *mesenteric* upon the *mesentery*; a large vein called *vena portæ*, which performs the office of an artery in distributing blood through the liver; the *femoral* vein in the thigh; and the *saphena* in the leg.

The exhalants are small arterial branches out of the general course of the circulating system, whose office is to pour out into particular cavities, or on the surface of membranes, those watery, mucous, and other fluids, intended for lubricating the surfaces of cavities and organs. They require here no particular description.

Circulation of the blood.—The reader is now prepared to understand the general circulation of the blood. Commencing with the right auricle, it proceeds in the following course: The blood from every part of the body, except the lungs, being collected by the branches and trunks, accumulates in the right sinus and auricle of the heart, from which it is poured into the right ventricle, when the latter is not contracting. The ventricle having received its blood, contracts, and, closing the valve of communication between it and the auricle, impels the blood into the pulmonic artery, by the trunks and branches of which it is distributed through the lungs. From these organs the blood is brought by the branches and trunks of the pulmonic veins, and collected in the left sinus and auricle, whence it is poured into the left ventricle. By the contraction of this latter it is propelled into the aorta, by the trunks and branches of which it is distributed to every part of the body, passes through the capillary vessels, and is collected by the branches and trunks of the veins, brought back to the right side of the heart, and circulated as before.

Thus it appears that the blood undergoes a double circulation, first through the lungs and then through the system. The blood is impelled through the arteries chiefly by the contractile power of the heart acting from behind, and the innate muscularity of the arteries. It is carried through the veins partly in consequence of the opposition to its return afforded by the valves, and partly by the pressure of the muscles contiguous to the veins.

The description just given applies chiefly to the adult state of man. There are some peculiarities both in the structure of the heart and the circulation of the blood before birth, which will be noticed along with other peculiarities of the *fœtus* in a subsequent chapter.

The blood contained in the *veins* and *pulmonic artery* is of a dark red, and that in the *arterial* vessels of a bright red colour, but this is the only sensible difference between them. When blood is drawn either from an artery or vein, it has a uniform red appearance; but if in any considerable quantity, on being suffered to stand at rest in a vessel, it soon separates into portions of a very different texture and consistence. A great part of the blood thus changed consists of a clear fluid, generally of a pale straw colour, resembling whey, and called the *serum* of the blood. Within this floats a solid mass called the coagulum, or clot, which consists chiefly of two portions, a pretty dense gelatinous substance above, and a deep red matter, easily broken, on the lower part. The upper gelatinous part is called *coagulable lymph*, and the under part is composed of what have been denominated the red globules of the blood. By heat the *serum* coagulates.

The specific gravity of blood is rather greater than that of water; it has an unctuous feel, a saltish taste, and, when fresh drawn, a peculiar odour.

The general differences in the circulating system among the inferior animals have been already noticed in the introduction. The particular variations respect chiefly the heart.

Heart of quadrupeds.—The heart of quadrupeds and cetaceous animals nearly resembles that of man, but is not situated in the same manner. It does not lie so much to the left side, and rests chiefly on the sternum, with its base forwards. The arteries in these animals are distributed nearly as in the human species; but in some particular tribes, especially the ruminating quadrupeds, those which go to the brain have the trunk more minutely divided, so as to check the impetus of the blood in the depending posture of the head which these animals employ in feeding. A similar minute division of the arterial trunks that supply the limbs occurs in some of those animals that are remarkable for the slowness of their motions.

Birds.—The heart of birds has a peculiarity of structure in the right *ventricle*, consisting of a strong tense muscle, nearly of a triangular form, so placed as to assist in driving the blood with greater force into the lungs.

Reptiles.—The heart of reptiles varies in the different orders. In the turtles, tortoises, and the crocodile tribe, it consists of a compound ventricle, with the compartments communicating with each other, and of two independent *auricles*; while in frogs, toads, and salamanders, it consists of a single undivided conical ventricle, and a single auricle. A similar structure to this last prevails in serpents.

The circulation through the lungs in reptiles and serpents is limited and imperfect; and from the immediate communication of the ventricles, the distinction between the venous and arterial blood is scarcely manifest. From this peculiarity of structure these animals are capable of suspending respiration when below water, or in other circumstances where they are prevented from receiving continued supplies of pure atmospheric air.

Fishes, &c.—In fishes the heart is small in proportion to the body, and exceedingly simple in its structure, consisting of a single auricle and ventricle, from the latter of which arises a single artery that passes to the gills, through which the blood circulates, and is brought from them to an artery that distributes it through the body. The blood-vessels of fishes are few in number. The heart of *mollusca* in general resembles that of fishes, but that of the cuttle-fish is composed of three muscular cavities analogous to ventricles. *Crustaceous* animals have a still more simple heart, consisting of a muscular cavity that propels the blood through the system before it passes to the gills. In no other of the invertebral animals below these is there any proper circulating system.

Nutrition.—It is chiefly through the medium of the arteries and the blood that the *nutrition* of the animal system seems to be effected, though we cannot properly explain the mode in which this is brought about. We know that the blood contains within itself the component principles of the animal body, and in the course of circulation these are deposited where they are required.

This affords some explanation of those remarkable phenomena that take place in many animals with respect to the reproduction of parts that have been injured or destroyed, as in the claws of crabs and lobsters, the tail and legs, and even the eye of reptiles, and the bones and some other parts of the human body. It also explains how parts that are separated may be reunited, and how a part taken from one animal may be made to grow to a newly cut surface in the body of another.

Sect. II. *Of Absorption.*

The absorbent system is composed of two sets of vessels and glands, and a general receptacle for collecting the absorbed fluids.

Lacteals.—One set of vessels and glands serve the purpose of conveying the chyle into the circulating system. The vessels, from containing the milky chyle, are called *lacteals*; and the glands, from being situated on the mesentery, are denominated *mesenteric glands.*

Lymphatics.—The other set of absorbing apparatus consists of vessels which, from containing a clear watery fluid, are called *lymphatic*, and of lymphatic glands. It is the office of these to remove superfluous fluids, to absorb matters by the skin, or convey away particles that are noxious or useless, or that are to be exchanged for new fluids.

The lacteal and lymphatic vessels resemble minute veins, except that their coats are thinner and more transparent, and they are provided with many more valves. They open upon the internal membrane of the intestines, and traverse the mesentery through the mesenteric glands. The lymphatic vessels are partly deep-seated, arising from internal cavities, or internal organs, and partly superficial, running longitudinally below the skin, as shown in the full length figure of Plate 10. These vessels also pass through lymphatic glands; and it is remarkable, that the vessels which leave the glands on the side next the heart are fewer in number than those which enter them from the opposite extremity.

Almost every part of the body is provided with absorbent vessels, which, whether called *lacteals* or *lymphatics*, have a similar structure and appearance, resembling jointed tubes.

Glands.—The mesenteric and lymphatic glands also nearly resemble each other. They are bodies of a flattened oval form, and of a reddish brown, or greyish colour. They are composed partly of numerous minute vessels, and partly of a pulpy matter, by which these appear to be connected, and they are each enveloped in a particular membrane. They are of various sizes, from that of a millet-seed to that of a small pigeon-egg, and are usually placed in groupes of three or four together. The lymphatic glands are most evident in the neck and about the large joints, as in the groins, arm-pits, and about the knees.

Thoracic duct.—The general receptacle in which the lacteals and lymphatics terminate is called the thoracic duct; but though the greater part of it is situated within the thorax, it appears to commence in the belly at about the third vertebra of the loins. It lies partly behind and partly on the right side of the aorta, sometimes single and sometimes double, and forms two remarkable expansions, the lowest of which is called the *receptacle of the chyle.* In the thorax it unites with the left subclavian vein, into which it empties its contents, to be thence carried to the right side of the heart.

A regular absorbent system, such as we have described in man, is not found in all the inferior classes, though it is probable that absorption takes place in all of them. In the higher classes the whole absorbent apparatus resembles that of man, and the differences that take place in the rest are not sufficiently remarkable to render a particular account of them necessary.

The mode in which absorption takes place has not been completely ascertained. It is supposed that the absorbent vessels exert an active power, in the first instance, in sucking up the matters they have to absorb; and though these matters often consist of the solid parts of the body, it should seem that these must be reduced to a more or less fluid state before entering the mouths of the absorbents. The absorbed fluids appear to be carried onwards from joint to joint, by what mechanical philosophers term *capillary attraction*, and in passing through the glands they probably undergo some necessary or important change.

Chap. V. Of Respiration and Voice.

All animals, whether they live in air, earth, or water, require occasional supplies of atmospheric air to renovate their blood or juices; and they have all organs, some extremely complicated, and others very simple, by means of which they alternately receive and discharge the air, or water mixed with air, by what is called *respiration.* Most of the more perfect animals also utter sounds, or have a voice, and their vocal organs are immediately connected with the general organs of respiration.

Sect. I. *Of the Organs and Phenomena of Respiration.*

The general organs of respiration consist of the *windpipe*, the *lungs*, and *diaphragm*, assisted in their mechanical action by numerous muscles. The upper part of the windpipe also contains the organs of voice in what is called the larynx.

Without at present minutely describing the organs of voice, it will be proper to take a general view of the larynx, and windpipe, from the commencement of the former at the root of the tongue, to the termination of the latter in the lungs.

Larynx.—Immediately at the root of the tongue is situated the *hyoidal bone*, or bone of the tongue, which has received its former name from its resemblance to a Greek letter. It consists of a body and two horns, with cartilaginous appendages, with which the upper and back part of the *larynx* is intimately connected.

The external part of the larynx is composed of several cartilaginous pieces, so united as to form a short tube attached at the top of the neck, and forming there a protuberance partly angular and partly rounded, while its back part next the gullet is chiefly composed of membrane and muscles. The most conspicuous part of the *larynx* is composed of two flattish, irregular, four-sided cartilages, which, by their meeting, form that angular protuberance so remarkable at the upper and fore part of the neck, called by anatomists *Adam's apple.* These two pieces united, form what is called the *thyroid cartilage.* Between these, on the upper part, there is a moveable oval cartilage, convex next the tongue, to which it is attached, and concave towards the aperture of the larynx, over which it is turned by the motion of the tongue in the act of swallowing, so as to prevent the food and drink from passing into the windpipe. Below the thyroid cartilage there is one resembling a ring, and thence called *cricoid*, or annular. This is the hardest part of the larynx, and completes that tube below, while two other small cartilages above and behind this, called *arytenoid*, make up the rest of the larynx. All these cartilages are connected together by ligaments and muscles.

Windpipe.—The windpipe commences immediately below the cricoid cartilage, passes down the fore part of the neck into the chest, and soon after entering this cavity divides into two branches, which pass, one on each side, into the lungs. The windpipe is a tube of considerable size, formed on its fore part and sides by circular cartilaginous rings, placed one below another, while its back part is flat and membranous where it is contiguous to the gullet. Its internal surface is lined with a mucous membrane, while its outer surface is covered with a strong fibrous membrane of considerable thickness. On the upper part of the windpipe, and extending over a part of

Respiration. the thyroid cartilage, is a body called the *thyroid gland.*

Cavity of the chest.—This is a bony cavity, of a conical form, broadest next the belly and narrowest at the neck. Its front is formed by the breast-bone and the cartilages to which the ribs are attached, its back part by the twelve dorsal vertebræ, while the ribs constitute its sides. It is lined internally by a dense serous membrane, which invests all the contents of the chest, and forms two doublings in the middle, extending from the inside of the breast-bone to the vertebræ, and forming a double partition called *mediastinum.* Thus the cavity of the chest is divided into three compartments, two lateral, containing the right and left lungs, and one central, containing the heart, the large blood-vessels, the gullet, and greater part of the *thoracic duct.* The floor of the chest is formed by the *diaphragm*, which is also covered next the cavity with the *pleura.*

Lungs.—The lungs are large, membranous, cellular, spongy bags, capable of considerable expansion and contraction, and supplied with numerous blood-vessels. They take their general figure from the cavities of the chest in which they are lodged, being convex next the ribs, a little concave next the diaphragm, flattened next the mediastinum, narrow above, and broad below; their colour is generally a brownish red, brighter in childhood and youth than in advanced age; they are smooth and glossy on their outer surface, and, in the healthy state, are easily compressible, and so light as to float in water. The lungs of each side are divided into several smaller portions, or lobes.

The greater part of the lungs is composed of an infinite number of very minute membranous cells, surrounded with cellular substance; and interspersed with innumerable ramifications of blood-vessels, with nerves and lymphatics. The membranous cells have no immediate communication with the surrounding cellular substance, but they freely communicate with each other by means of short pipes, which gradually become larger and more cartilaginous as they approach the divisions of the windpipe. The blood-vessels consist partly of those which nourish the lungs, but chiefly of the ramifications of the pulmonic artery and veins which circulate the blood through the lungs. The blood thus circulated does not enter the membranous cells, but passes round them, within its proper vessels.

Diaphragm.—The diaphragm, or midriff, is that extensive partition which separates the chest from the belly. It is composed partly of fleshy and partly of tendinous fibres. At its sides it is attached to the ribs, in front to the sternum, behind to the dorsal and lumbar vertebræ, and in the middle to the *mediastinum*, in such a manner that it forms two convex surfaces towards the chest, and two corresponding concavities towards the belly. It is perforated with several holes, especially one forward and towards the right side, for the passage of the great ascending vein; a second near this, but more in the centre, of an oval form, for the gullet; and a third behind this, for the descent of the great artery, or *aorta.*

Respiration.—This function is partly mechanical and partly chemical. The air inhaled by the mouth and nostrils enters the larynx, and, by its own weight, descends through that tube and its ramifications into the air cells of the lungs. To assist this *inspiration*, the cavity of the chest is enlarged, partly by drawing up the ribs by the muscles suited to that office, and partly by the contraction of the muscular fibres of the diaphragm, by which its convexities next the cavities of the chest are flattened. When the cavity of the chest is thus enlarged, the air cells of the lungs are expanded by the rarefaction of the air which they contain, and readily admit the introduction of fresh air from without. While the lungs are thus dilated, the blood sent to them from the heart flows more freely than when they are in a contracted state.

Inspiration being completed, expiration follows. This is effected chiefly by the abdominal and neighbouring muscles drawing down the ribs, while the muscular fibres of the diaphragm are relaxed, and this partition is pushed towards the chest by the pressure of the contents of the belly. This action is assisted by the elasticity of the air-cells of the lungs, and of the cartilages of the ribs, by which the former are naturally contracted, and the latter drawn downwards.

A healthy adult man respires about twenty times in a minute, and appears to take in, during an ordinary inspiration, about forty cubic inches of air.

The chemical effects of respiration respect either the changes produced on the respired air, those produced on the blood that passes through the lungs, or those effected in the system at large.

It is found that the air respired suffers a sensible diminution in its bulk, though this is probably but trifling, amounting to about six parts in a thousand; that during respiration the air loses a part of its oxygenous constituent; that it acquires an additional quantity of carbonic acid, or fixed air; and that it is emitted by the lungs impregnated with watery vapour.

Hence it appears that, during respiration, a small quantity of atmospheric air is absorbed, that oxygen is consumed, and that carbonic acid and water are produced.

As the blood sent to the lungs by the pulmonic artery is of a dark red colour, while that brought back by the pulmonic veins is of a florid red, it is evident that a change has been effected on it by passing through the lungs. It appears that this change consists chiefly in the loss of its hydrogen and carbone, acquired in its circulation through the system, which is attracted by the oxygen of the respired air producing water and carbonic acid. The chemical theory of respiration is, however, still imperfect.

The effects produced by respiration on the system at large are partly the increase of vital energy and activity, produced by the exciting power of the arterial blood, and partly the support of animal heat.

Experience shows, that, when the breathing is free and rapid, the circulation is most vigorous and active; that breathing a pure, clear atmosphere, excites agreeable sensations in the mind, and disposes to mirth and cheerfulness, while the animal motions are rendered free and vigorous, and the digestive powers are increased; whereas, when respiration is impeded, or when a person is compelled to breathe an impure atmosphere, the circulation, especially through the lungs and head, becomes slow and languid, a peculiar anxiety is felt at the breast, which is partially relieved by yawning, sighing, or a deep inspiration; the head becomes heavy and oppressed; the face swells, and generally feels heated; the sight becomes blunted or depraved; the mind confused; and muscular action is rendered feeble and languid.

Animal heat.—Physiologists are now generally agreed, that animal heat depends chiefly on respiration. Those animals whose respiration is quickest and freest, as birds, have the greatest temperature, while those whose respiration is slowest and most languid, as reptiles, have their temperature proportionally low. The natural healthy temperature of the human body, or what is called blood heat, is about 98° of Fahrenheit's thermometer. To account for the production and continuance of animal heat, it is supposed that the venous blood, in passing through the lungs, imbibes a quantity of that heat which is extricated during the decomposition of the atmospheric air, or has its specific heat increased, and that in circulating through the body it imparts a portion of this heat to the parts to which it is distributed.

Few circumstances are more remarkable in the animal economy than the power which animals possess of preserving an equable and moderate temperature. Most of them can exist for a considerable time in air heated to a degree greatly superior to that of the blood, or cooled below the freezing point; and still, while life remains, the heat of the body is not materially increased in the former, or materially diminished in the latter case. A dog has been kept in air heated to 260°, without having his heat increased more than 2°, and men have breathed an atmosphere of 130° without being greatly incommoded. Alligators and fish have been found sporting at their ease in the waters of a hot bath; while, on the other hand, many reptiles have been enclosed in a block of ice, and still survived. These phenomena are to be attributed to the conservative effects of the vital principle; but we know that in those animals which perspire, a free and copious perspiration, the natural effect of increased heat, contributes to cool the surface of the body, and preserve its equability of temperature.

Torpidity.—The periodical torpidity, or *hybernation*, that takes place in many different animals, is intimately connected with the general phenomena of respiration. Among quadrupeds, three species of bats, at least two of bears, the badger, the hedgehog, the hamster rat, some marmots, the dormouse, and a few others, pass the greater part of winter in a state of inactivity, differing from sleep in the slowness of their circulation and respiration, and their little susceptibility of impressions from external *stimuli.* The same circumstances take place in a still more remarkable degree among tortoises, lizards, and other reptiles; and some birds and fishes, though *hybernation* is not common in these classes, are occasionally found in a state of torpor. Most insects that survive the autumn pass the winter in a torpid state; and even man has been known to remain for several days in a state of suspended animation, from the effects of cold, without finally perishing.

It is chiefly, however, in quadrupeds and reptiles that the phenomena of hybernation have been minutely examined; and the following is the result of the examination. During this state of torpidity, the animals appear scarcely to live; their sensation seems entirely suspended; their irritability is so much diminished, that they may be cut, torn, or have their legs or tail broken off, without giving any signs of motion, or expressing any mark of feeling. Their digestion, or at least their appetite for food, is also suspended, and their secretions and excretions are discontinued. The only functions which appear to be carried on, and shew that vitality is not entirely extinct, are those of circulation and respiration, which are so languid, that the animal can but just be said to breathe, and the heart to beat. In some quadrupeds too, the absorbent system still continues active; for these animals are commonly very fat when they retire to their winter quarters, but quite emaciated when they leave them in the spring. This, however, is scarcely the case with reptiles, which are found to lose very little of their weight during hybernation. In those animals which hybernate under the protection of man, it is found, that if they are removed from their retreats, and exposed to a gentle heat, they partially recover the use of their faculties, and sink again into torpidity, when remanded to their cell; but if the heat to which they are exposed be too great, or too suddenly applied, the animal is commonly destroyed.

To what immediate cause these phenomena are to be attributed, has not yet been satisfactorily ascertained. There is no doubt that they are connected with a languid state of respiration, and this seems to be one of their most constant precursors; but this alone does not afford a sufficient explanation.

The comparative anatomy of the general respiratory organs, offers many and important varieties. In most quadrupeds the lungs are similar to those of the human subject; but in those which live chiefly in the water, as the sea-horse, and in cetaceous animals, the lungs are long and flat, are not divided into lobes, and adhere to the diaphragm and to the pleura, and this last membrane is of a firmer texture than in man and most quadrupeds.

There is one peculiarity in the respiratory organs of cetaceous animals that requires particular notice. There are in the skull of these animals two bony canals proceeding from the back of the mouth, traversing the interior of the skull in a curved direction, and opening externally in some part of its upper surface. These canals constitute what are called the blowing holes, and it is through them that the animals spout those jets of water which form so remarkable an object in the Greenland seas. These canals generally unite, except in the proper whales, near the top of the head, and form externally a single opening. There are numerous membranous and bony cavities connected with these canals, and muscles for contracting and regulating their diameters.

Cetaceous animals, in their usual attitude, are incapable of breathing through the mouth, and are

Respiration. therefore provided with these openings at the top of the head, which is generally out of water; and these openings serve both as nostrils to admit the passage of air to and from the lungs, and to discharge the water taken in by the mouth along with the food.

The lungs of birds are small, flattened, adhere above to the chest, and are covered by the *pleura* only on their anterior surface. The air cells are of considerable size, and the lungs are not divided into lobes. There are also membranous air cells extending to the belly, and among them are muscular fibres which seem to supply the place of the diaphragm, an organ that is not found in birds. Besides the membranous air cells, there are large vacuities in the bones of birds, particularly in the blade bone and thigh bone, which are filled with air instead of marrow.

In reptiles the lungs are proportionally larger, and of a looser texture than in quadrupeds and birds, and the air cells are in general of considerable size. In these animals, too, there is no diaphragm. In the tadpoles of toads, frogs, and salamanders, which pass the earlier stages of their existence entirely in the water, there are also temporary gills, consisting of several fringed vascular membranes, projecting on each side of the neck, and communicating with the back of the mouth. When the animals approach their perfect state these drop off; but there are two species of reptiles, the proteus and the siren, in which they are permanent. In serpents there is properly but one lung, consisting of a very long spongy bag, a great portion of which forms a single cavity, while the other cells are very large. They also have no diaphragm.

This simplicity of structure in the lungs of reptiles and serpents is well suited to their habitation and manners of life. They are thus enabled to receive a large quantity of air at once, and to retain it for a considerable time, while the very open texture and little vascularity of their lungs make them swim and dive more readily. The respiration in these animals is naturally very slow, and can be suspended for a very considerable time.

Fishes have no lungs, but respire by means of gills, which are placed on the sides of the neck, and generally consist of four vascular plates, attached immediately to as many arched bones or cartilages, which are connected with the *hyoidal bone*. In the bony fishes there is but one external opening to the gills of each side, and this is covered with a bony or cartilaginous lid, which opens and shuts alternately as the animal respires. In the cartilaginous fishes there are several openings to the gills on each side of the neck, and no gill-covers.

Most crustaceous animals have gills situated near the attachment of the legs. Some of the mollusca, too, as the snail and slug, have similar organs, communicating with the external air through a small aperture in the side of the neck, that can be opened and shut at the pleasure of the animal. It does not appear that any of these last animals inspire air by the mouth.

Insects have air vessels passing below the skin along the body, which are largest in the caterpillar state. They communicate with the air by apertures called *stigmata*. In general these openings are placed on both sides of the body. Respiration.

The respiratory organs of worms resemble those of insects; but zoophytes, though they evidently require atmospheric air, or water that is impregnated with this air, have no perceptible breathing organs.

Sect. II. *Of the Organs and Phenomena of Voice.*

A great variety of animals are capable of producing sounds, but only the vertebral animals possess what may be called vocal organs, and of these animals a great many are entirely dumb. The most remarkable for voice are a few quadrupeds, most birds, and some reptiles and serpents.

The essential vocal organ is the *larynx*, assisted in the propagation of sounds by several of the neighbouring cavities, and assisted also in their articulation, in those animals that possess an articulate voice, by the tongue, the lips, the teeth, and the palate.

The external part of the human larynx has already been described; it remains to notice its internal parts, which are more immediately concerned in the production of vocal sounds.

This internal part of the *larynx* is called the *glottis*, and consists chiefly of several membranes, which are so situated and connected with the external cartilages, and with numerous muscles, as to produce an almost incalculable variety of tones, by regulating the quantity and velocity of the air which is made to pass through them in a given time. Two of these internal membranes have the appearance of fibrous bands, running from the side of each *arytenoid cartilage* to the internal fore-part of the *thyroid cartilage*. At this latter part they meet and diverge from each other towards the back part, but in such a manner that the space between them, constituting the principal opening or *chink of the glottis*, is capable of various degrees of contraction and dilatation, according as the *arytenoid cartilages* are made to approach each other by the action of the contiguous muscles, or recede from each other by their own elasticity. Below these are two other ligamentous membranes, having similar attachments with the former, but larger, and generally more distinct, though not moveable to the same extent. Besides these, there is on each side a membranous cavity, produced by a reflection of the membranes already described, and these are called the *ventricles of the glottis*.

The several parts of the larynx, including the glottis, have their motions varied and regulated by 23 pairs of muscles. Hence it may easily be conceived how great must be the variety of tones and inflections capable of being produced by the human voice; especially if we consider that to these must be added as assistants all the muscles that act upon the tongue, the lips, and the lower jaw, and even the principal muscles of respiration. It is computed that the number of combinations, and consequently of varieties of sound, capable of being produced by these muscles, co-operating in different manners with each other, amounts to above 17,000,000,000,000.

The general mechanism of voice and speech requires but little explanation. In the ordinary silent state of the vocal organs, the membranes and muscles of the *glottis* are in a state of relaxation; but when, Respiration. by the contraction of the muscles, and consequent approximation of the membranes, the chink of the glottis is diminished, sound, or voice, is produced, and this is more or less shrill according to the contraction of the aperture, and more or less loud according to the quantity of air forced through it in a given time. By this variation in the glottis alone, however, only inarticulate sounds, or vowels, are produced. To utter articulate sounds, we call in the aid of the tongue, the lips, the palate, the teeth, and even the nose, and the articulation is more complete according as these parts are perfect and healthy. Swelling or soreness of the tongue, dryness, or imperfections in the lips, loss of the front teeth, deficiency in the palate, or obstruction in the nostrils, each contributes to render the speech imperfect and indistinct.

Several quadrupeds have a characteristic voice, produced by peculiar organs, consisting, as in man, of four tense membranes and membranous cavities, with the addition, in some instances, of a sinus in the *hyoidal bone.*

The *neighing* of the horse seems to be produced by the vibrations of a delicate laminar membrane, attached by its middle to the thyroid cartilage, and having its extremities running along the external edges of the opening of the *glottis*. The *braying* organs of the ass consist of a similar membrane, with two large membranous bags communicating with the larynx, and a hollow in the thyroid cartilage. In the cat there are two delicate membranes situated below the ordinary membranes of the *larynx*, the vibrations of which are supposed to occasion *purring*. Two species of monkey, generally called *howling apes*, from the loud and horrible sounds they occasionally utter, appear to produce these by reverberating the air through a spherical cavity in the *hyoidal bone*. The *lowing* of cattle, and *bleating* of sheep, depend probably on the large cavities in their skull and horns.

There is a peculiarity in the larynx of cetaceous animals, which is thought to disqualify them from uttering peculiar sounds. This consists in a considerable swelling, or dilatation, below the opening of the *glottis*, while this latter is very much contracted. It is, however, asserted by those who have observed these animals in their native element, that they emit sounds resembling a dull lowing or bellowing.

In birds, the windpipe is provided with two larynxes, one at each extremity, having a peculiar opening, provided with membranes. It is also remarkable that these organs frequently differ in the male and female birds. Thus, in the male of the wild swan the windpipe makes a large convolution, which is contained in the hollow of the breast-bone, whence it is enabled to make a whistling sound, while the female, especially in the tame swan, has this organ straight, and is dumb. The windpipe of singing-birds very much resembles a flageolet, or similar wind instrument, having the reed, or mouth-piece, next the lungs, and the orifice, by which the sounds are regulated, analagous to the holes of the instrument, next the head.

It is supposed that only two species of reptiles are entirely dumb. Many of them have characteristic voices. Thus tortoises hiss or sigh; crocodiles low or roar, sometimes in a very loud tone, and the young of these animals utter piercing cries, said to resemble the mewing of a cat, when they are attacked; guanas whistle; and frogs and toads croak. Still it would appear that the vocal organs of reptiles are very simple, consisting of a single larynx, without epiglottis; but in frogs and toads, especially in the males, the membranes of the glottis are very large, and there are peculiar cavities in the sides of the head or neck connected with the glottis.

Serpents, like reptiles, have no epiglottis, and their larynx is extremely simple. Many of them are dumb, and the voice of the rest consists only in hissing.

The voice of animals alters with age; it is shriller in the young and very old, and deeper in middle-aged animals.

It is remarkable that some animals lose their voice when carried to particular countries. Thus it is said that dogs in some parts of America never bark; and that quails and pigeons in Siberia are altogether dumb.

Chap. VI. Of Secretion and Excretion.

Secretion. *Secretion* is that function in the animal economy by which certain principles are separated from the general mass of blood, by peculiar organs, for some important purposes in the system. *Excretion* differs from secretion in separating those matters which would be injurious to the system if retained, and throwing them out of the body. The secreting and excreting organs are either membranes or glands. The former, as affording covering and defence to the several parts of the body, more properly fall to be considered under the head of integumation in the following chapter; the latter will be immediately described. These consist chiefly of the *liver*, the *pancreas* or sweet-bread, the *spleen*, and the *kidneys*, with several other lesser glands, that have either been already noticed, or will be mentioned in a subsequent chapter.

The glands just enumerated lie within the belly; and as they form the only contents of that cavity not already described, it is necessary now to consider the form and composition of the belly.

The belly extends in front from the ensiform cartilage of the breast-bone to the share-bone or *pubes*; behind it is bounded by the *vertebræ* of the loins, and at the sides by the lower ribs above, and by the haunch bones below. Its sides, or walls as they are called, are composed chiefly of large and strong muscles, interspersed with fat and cellular substance, and it is lined within by a serous membrane called the *peritoneum*, which has numerous doublings that invest all the contents of the belly.

This cavity is divided by anatomists into nine parts, or regions. That part in front, extending from the pit of the stomach to within about an hands-breadth of the navel is called the *epigastric* region, as lying above the stomach, and this is bounded on the right and left by two *hypochondriac* regions, so called from being situated chiefly below the cartilages of the ribs. The middle regions are the umbilical or navel region, with the *right* and *left lumbar* at its sides; and below these lie the hypogastric in front, and the *iliac* regions to the right and left.

The *liver* is the largest gland in the human body. It is situated chiefly in the *right hypochondriac* and *epigastric*, and partly in the *left hypochondriac* regions, and is divided into two principal lobes called right and left, of which the former is the larger. It is convex towards the ribs and *diaphragm*, concave towards the stomach and bowels, a little flattened and broad at its back part, and having a sharp edge for its anterior margin. It is supported and connected to the adjacent parts, by membranous ligaments, either formed by doublings from the *peritoneum*, or covered by that membrane. Its lower surface is extremely irregular, from numerous hollows and protuberances; and here are numerous vessels and tubes connected with the liver, in particular the hepatic artery and veins, and the great vein called *vena portæ*, entering by what is called the gate of the liver, and performing the office of an artery in distributing the blood through the glandular substance of this organ. Hence the liver is extremely vascular, but its vessels are so minutely divided, and so intermixed with the proper substance of the gland, that when cut into, it exhibits a very uniform appearance, and pretty solid consistence. It is of a dusky red colour, and sinks in water.

Connected with the liver is a hollow receptacle, chiefly membranous, but partly fibrous, by some supposed to be muscular, and called the *gall-bladder*, as receiving and retaining for a time the bile secreted by the liver. This bag is of an oblong form, is attached through its whole length to the concave surface of the liver, and communicates directly with it by numerous tubes or ducts. From its smallest end or neck proceeds a pipe called the *cystic duct*, which soon unites with a similar tube called the *hepatic duct*, coming directly from the liver; and these two uniting form a common tube by which the bile is conveyed into the *duodenum*.

Bile is brought continually from the liver by the hepatic duct, and occasionally from the gall-bladder by the cystic, and the fluid from both these sources is of the same nature, except that what is collected in the gall-bladder acquires a greater consistence, and deeper colour, in consequence of the absorption of its thinner parts. Bile is a dark greenish fluid, of considerable density, viscid to the feel, of a bitter taste, and a peculiar unpleasant odour. Its specific gravity is greater than that of water. When agitated, it becomes frothy like a solution of soap, readily mixes with water, and forms with it a yellowish fluid.

The bile appears to be secreted in the glandular substance of the liver from the blood of the *vena portæ*. It undoubtedly serves important offices in the animal economy, the chief of which are probably to separate the chyle from the excrementitious part of the aliment, and by its stimulating property to propel the latter through the intestinal canal.

Only the proper worms and zoophytes appear to be entirely without a liver or analogous gland; for it is found at least in every animal that has a complete circulating system.

The liver of quadrupeds is much more minutely divided than that of man especially, in those that are *carnivorous*. In many of those animals, especially in the rat, hare, guinea-pig, and sloth tribes, in the elephant, rhinoceros, deer, and camel, in horses, seals, and walrusses, there is no *gall-bladder*, and in general this organ is confined to *carnivorous quadrupeds*.

The liver of cetaceous animals is divided much in the same way as in the human species. None of these animals have a gall-bladder.

In birds the liver is divided into two equal lobes, and the hepatic duct is distinct from the cystic. The liver is larger in domesticated than in wild birds. In general these animals have a gall-bladder; but it is wanting in some species, particularly the parrot and the pigeon, the latter of which has been proverbial for having no gall, an assertion which is not strictly true.

The liver of reptiles is always large, and in some, as the salamander, it is of very considerable magnitude. It is generally divided into two lobes, but is sometimes simple, especially in lizards. All reptiles have a gall-bladder but this is proportionally smaller than in quadrupeds and birds. A similar structure is found in serpents.

Many fishes have the *liver* of considerable size, and many of them have a *gall-bladder*. In some cases the liver surrounds the intestinal canal, and it frequently abounds with oil, even in those fish that are generally destitute of fat, as the skate and cod.

All the mollusca have a liver, which is generally very large; but it does not appear that these animals possess a gall-bladder.

In crustaceous animals there is a large organ analogous to the liver, consisting of several tubes, closed at one extremity, and opening at the other into the intestinal canal.

There are in insects several processes attached to the alimentary canal, and containing a bitter yellow fluid; and these are considered to be their biliary organs.

The *pancreas* may be considered as a large salivary gland, more immediately connected with the digestive organs than those of the mouth, as it secretes a fluid very similar to saliva, and evidently destined to assist in the process of chylification. It exists in almost all the vertebral animals, and its structure is pretty uniform in the several classes. In man it is of a long flattened form, having a small angular protuberance at the end next the duodenum. It is of a greyish colour, and internally is composed of numerous small lobes, connected together by a cellular membrane, and invested with a general external coat. Along its whole length runs a whitish tube, connected with numerous small tubes on each side, and passing in nearly a straight direction to the *duodenum*. It is situated across the belly, and behind the stomach, with its flat sides pointing forwards and backwards; and being among organs that are much exposed to motion, the progress of its secreted fluid through the general tube is thus accelerated. This fluid is commonly called the pancreatic juice.

The *comparative* differences in this organ relate chiefly to its colour, consistence, form, and composition; but these are not so important as to require particular notice here. The pancreatic ducts are sometimes more numerous than in man, and enter the duodenum by openings at a distance from the biliary ducts.

The spleen is found in all the vertebral animals, and its situation and structure are pretty uniform in all. It varies in form, size, colour, consistence, and vascularity. It is largest in man and quadrupeds, and smallest in fishes.

The spleen of the human subject is of considerable magnitude, though much less than the liver. It is placed in the left hypochondriac region, between the cardiac extremity of the stomach and the false ribs, being contiguous to the diaphragm above and to the *côlon* below. Its general figure is an oblong oval, a little compressed. It is of a soft consistence, and of a purple colour. It is sometimes cleft about the edges, and as if formed of different lobes. It is extremely vascular, being inferior in this respect only to the lungs and liver, and, like the latter, it is partly of a glandular structure, consisting of numerous cells of a whitish colour, containing a peculiar fluid.

The uses which the spleen answers in the animal economy are not yet well understood. There is an intimate connection between its vessels and those of the stomach. It has lately been conjectured, that one of its principal uses is to carry off from the stomach a part of its fluid contents to the *urinary bladder*, by a shorter passage than through the absorbent vessels.

In those quadrupeds that have a compound stomach, the spleen is situated near the *paunch;* and in the ox and sheep it is more evidently cellular than in the rest of this class.

In some cetaceous animals, as the porpoise, the spleen is composed so as to appear as if there were several. As in the ruminating quadrupeds, these are most immediately connected with the first stomach.

In birds this organ is situated just before the left lobe of the liver, within a doubling of the *peritoneum*.

Among the reptiles, the spleen of turtles and tortoises is kidney-shaped. In lizards and salamanders it is oblong, while in frogs and toads it is spherical. It is generally situated in the mesentery, pretty near the *rectum.*

The situation of the spleen in fishes is generally near the commencement of the alimentary canal. Its form in this class is extremely variable.

Before describing the kidneys, it will be proper to notice some *peculiar secretions* that take place among the inferior animals. Thus, among quadrupeds, the beaver has certain glands near the extremity of the rectum, in the form of oblong bags, which secrete that peculiar resinous matter called *castor;* and the civet-cat and musk animals have appropriate organs for secreting the odoriferous substances from which they derive their names. Several species of weasel have the property of producing a very offensive matter from the pores of the skin, when they think themselves in danger of being injured, and thus driving off their assailants.

Among cetaceous animals, the cachalots produce, in cells within the skull, and in some other parts of the body, that concrete oily substance commonly called *spermaceti;* and *ambergris* is a product of the same tribe, being generally considered as a concretion formed within the intestinal canal.

Birds have peculiar glands situated on the rump, near the root of the tail, from which is derived the oily fluid with which they trim their feathers. These organs are most remarkable in water birds, whose feathers are consequently very greasy.

Some peculiar secretions take place in reptiles, as the acrid liquor secreted from the feet of geckos, said to be of a poisonous nature, and the irritating fluid which exudes from the skin of toads and salamanders when injured. The most remarkable secretion in serpents is the venom collected in bags at the root of the upper tusks in the vipers and rattlesnakes.

In fishes there is a mucous fluid produced in tubes below the skin, and poured out by tubes or pores between the scales, for the purpose of lubricating the external surface of the body.

Many remarkable secretions take place among insects, as that viscid fluid formed by silk-worms, which afterwards hardens into the strong and beautiful matter of silk, and a similar glutinous liquor that produces the web of the spider; that acrid matter, somewhat similar to the poison of serpents, situated at the root of the sting in bees, wasps, hornets, &c.; the *lac* that constitutes the basis of sealing-wax, the acrid matter of cantharides, the colouring matter of cochineal, and several others.

Among the mollusca, the ink of the cuttle-fish forms one of the most remarkable secretions; and perhaps we may reckon among those secreted substances the silky threads by which the sea-mussel and some other testaceous mollusca attach themselves to the rocks.

The kidneys are glands fitted for separating the urine from the mass of blood. They are found in all the vertebral animals, and are pretty uniform in their situation and figure. They are always two in number, and are generally connected with a membranous receptacle, or bladder, into which the urine is conveyed by proper pipes, called *ureters*, and where it accumulates till it be discharged. Hence the kidneys may be regarded as both secreting and excreting organs.

The kidneys in man are situated in the right and left lumbar region, near the spine, and consequently in what is called the small of the back, lying in such a manner behind the bowels that the top of the right kidney is immediately below the right lobe of the liver, and the upper extremity of the left contiguous to the lower part of the *spleen*, the right being generally a little lower than the left, and their upper extremities rather longer than their lower. They are of a firmer consistence than either the liver or the spleen, and of a pale red colour. They are the only contents of the belly which are not covered by the *peritoneum*, but are involved in a considerable quantity of loose, fatty, cellular substance, from which is partly derived the proper membrane that covers the

Secretion. outer surface of the kidneys, which is of a whitish colour and fibrous texture. The kidneys are less vascular than the liver or the spleen. They are composed of two substances of different structure and consistence, one called the *cortical substance*, as it forms the outer part of the gland, of a dark colour and pretty soft consistence, the other called *medullary*, consisting of several conical divisions, terminating in what are called papillæ, which converge towards the concave depression on the inner side of the kidney, where they unite in a membranous cavity, from which rises the membranous tube called ureter.

The urine appears to be formed in the medullary part of the kidney, and collected by the membranous tubes into the cavity at the commencement of the ureter, whence it passes through these tubes, *i. e.* one to each kidney, to the bladder. The ureters pass behind the *peritoneum*, from which they receive a part of their investing membrane. They are simple membranous tubes, but not regularly cylindrical, and they are capable of considerable dilatation.

The *human bladder*, when distended, is nearly of a spherical form, a little flattened in front. It lies in the fore part of the *pelvis*, just before the *rectum*. It is partly membranous and partly muscular, and is perforated obliquely behind and near its lower part or neck, by the two *ureters*. It is attached to the neighbouring parts by membranes and ligaments, and to the *navel* by a ligamentous cord.

The general appearance of the fluid separated by the kidneys is well known. It is of rather greater specific gravity than water, and contains in solution a great variety of saline matters, and a particular substance called *urea*.

It is unnecessary to be more minute respecting this excretion in the human body. We shall therefore proceed to a comparative view of the functions in other animals.

The kidneys of quadrupeds vary chiefly in composition. In some tribes, especially the carnivorous quadrupeds, they are extremely simple; while in others they consist of numerous lobes, loosely connected by cellular substance. This structure is so remarkable in bears, that each of their kidneys resembles a bunch of grapes. All quadrupeds have a urinary bladder, which is proportionally smaller in carnivorous than in herbivorous quadrupeds; and in particular is very large in the hare and in cattle. It is more loosely connected with the neighbouring parts in quadrupeds than in man.

The kidneys of cetaceous animals are longer, flatter, and more lobular than those of quadrupeds, and the ureter proceeds from their posterior extremity. The bladder in these animals is comparatively small, and of an oblong form.

In birds, the kidneys consist of a double row of glandular bodies, situated on each side of the lumbar vertebræ. There is no urinary bladder in this class, and the *ureters* empty their contents immediately into the cloaca.

The structure of the kidneys in reptiles and serpents is extremely simple, but their form and situation vary. In tortoises they are short and thick, and are situated in the posterior part of the belly. In lizards, they are of an oblong, oval, flattened form, and lie very near the tail. Tortoises, chameleons, dragons, guanas, stellios, salamanders, toads, and frogs, have a urinary bladder, which is single in all but the three last tribes, in whom it consists of two membranous bags. Of course, in those that have no bladder, the ureters terminate as in birds.

Though all fishes possess kidneys, the majority of them are destitute of a urinary bladder.

There are several other *excreting organs* in the animal body. Thus, the skin excretes the *perspirable matter*; the lungs, *watery vapour*; and the bowels the *excrementitious part of the aliment*; but the consideration of these organs does not belong to the present chapter.

Chap. VII. Of Integumation.

Integumation. The whole surface of the body, all the internal cavities, whether muscular or bony, all the bones, muscles, blood-vessels, nerves, and, in short, almost every component part of the animal body, are invested or lined by membranes, differing from each other in their nature, texture, and extent. Many of these are secreting surfaces, and might therefore have been treated of in the preceding chapter; but as even the fluids they secrete chiefly serve the purpose of adapting them better to integumation or defence, we have thought it preferable to bring the whole under one connected view in the present chapter.

The most general investing organ of integumation is the *cellular membrane*, which serves partly as a covering and partly as a mean of separation to every organ and almost every fibre of the body. It is composed of filaments and plates, intimately interwoven, and crossing each other in every direction, forming, by their interstices, numerous spaces or cavities filled with a serous fluid or fatty matter. The fibres of which it is composed are of a whitish colour, and elastic.

The cellular membrane is one of those organs which perform more than one important office in the animal economy. Besides covering and defending the parts which it surrounds, the cells of that part of it which is most external, and which cover certain organs, as the kidneys, the heart, &c. contain and probably secrete the fat, and hence this part has been called the *adipose membrane*. This fatty matter not only serves the purpose of preserving the equable temperature of the parts which it surrounds, and preventing friction by its lubricating quality, but seems also, in many instances, especially in those quadrupeds that pass the winter in a torpid state, to supply the want of food.

There are some animals in whom this fatty matter is particularly abundant, and these are generally inhabitants of the waters. Thus all the cetaceous animals have a very thick layer of fat cellular membrane lying between the muscles and the skin, constituting what is called the *blubber*. A similar structure, but to a less extent, obtains in the aquatic quadrupeds, especially seals and walrusses, which are commonly hunted for the sake of their oil. Many fishes, too, especially the salmon and the herring, have a considerable quantity of oil within their cellular mem-

Integumation. brane, though, in general, these animals are very deficient in fat.

Another very general investing *membrane* is that called *serous*, from the watery fluid which bedews its inner surface. Membranes of this class are found in all the great cavities of the body. Within the head they constitute a delicate reticulated membrane, lying within the *dura mater*, and called the *arachnoid coat* of the brain; within the chest they form the *pleura*, and in the belly the *peritoneum*. Each of these may be said to form a distinct bag, though, in some measure, they communicate with each other through the openings between adjacent cavities. The serous membranes are of a whitish colour, of a shining appearance, having a rough, irregular surface towards the parts to which they are immediately attached, and one that is smooth and even next the cavity of which they form the lining. They are of a cellular rather than of a fibrous texture, capable of considerable though gradual dilatation, in a small degree contractile and elastic, but possessed of little sensibility.

A third membrane, scarcely less universal than the preceding, is that called *mucous*, which lines all the cavities that communicate with the external air, as the nose and contiguous sinuses, where it constitutes the *pituitary membrane*; the *larynx*, windpipe, bronchiæ, and, probably the air-cells of the lungs, the mouth, pharynx, gullet, stomach, and intestines, and all the excretory ducts, opening externally from glands or membranous receptacles. Like the former they have two surfaces, an inner, rough and irregular, and an outer, or that next the cavity, smooth and moist, but seldom regular. These surfaces, however, are composed of distinct layers, and have between them numerous small glands that secrete the mucous fluid, for which these membranes are so remarkable. The mucous membranes possess but little sensibility and contractility, though they are capable of very great dilatation.

A fourth class of investing membranes is called *fibrous*, because, more than any of the rest, they are composed of distinct fibres. Among these are the *periosteum* that covers the bones, and the *aponeuroses*, or sheaths, that envelope the muscles on the arms and thighs, the *capsular ligaments* of the joints, the *dura mater* of the brain, the sclerotic coat of the eye, &c. These are of a white glistening colour, resembling tendons, and, though sometimes connected with secreting membranes, appear to perform no secreting office in themselves.

These are the principal *internal* organs of integumation. The external are the skin, the mucous network, and the cuticle, with its numerous appendages of hair, nails, horns, hoofs, feathers, scales, shells, &c.

Skin.—The skin in the human body is composed of three distinct layers, the *corion*, the *reticular portion*, and the *papillary*, or nervous portion. The corion constitutes the substance of the skin, and is of various degrees of thickness in different parts of the body, being thickest in the palm of the hand and soles of the feet, the back, the skull, and back of the neck, while in some parts, as the lips, it is extremely thin and delicate. It is of a fibrous texture, and the fibres cross each other in every direction, and are interspersed with numerous blood vessels, nerves, and absorbents. They are of a white colour, of a gelatinous texture, and capable of considerable extension. The *corion* is every where perforated with numerous holes, constituting what are called the pores of the skin, which are arranged so as to form pretty regular angular figures of three, four, or five sides. The *corion* gives strength and firmness to the skin, and forms a connecting membrane for its nerves and vessels. In itself, it appears to have little connection with the sense of feeling.

The *reticular portion* forms the outer surface of the true skin, and appears to be produced by the ramification of numerous vessels passing through the pores of the corion, and forming a sort of net-work upon its surface. It is in this layer that the pustules of small pox and similar eruptions have their seat; hence it has been called, by Mr Cruickshank, the *membrane of the small pox*.

The *papillary*, or nervous portion of the skin, is that which covers the outer surface of the corion below the reticular portion, through the meshes of which last the papillæ project, and thus appear to form the outer layer of the skin. This portion appears to consist of the extremities of those nervous filaments that are distributed through the *corion*, and forms the immediate organ of feeling. The papillæ are arranged in bundles of small white fibres, not always of the same length, forming a sort of pencil. They are situated very close to each other, and form together a *villous* surface, well suited to receive impressions of feeling. They are found on the outer surface of the corion wherever this membrane has been examined by the microscope, but they are most remarkable at the point of the fingers, in the lips, in the palms of the hands, and soles of the feet. Hence, probably, these parts are so susceptible of tickling. The nervous papillæ are most evident when stimulated by the gentle contact of an external body, and they are generally most sensible in females and young persons.

The surface of the skin is kept moist, and the sensibility of the papillæ preserved, partly by the matter of perspiration, and partly by an oily fluid formed by very minute glands, called *miliary* or *sebaceous*, which are particularly abundant in some parts of the body, as in the arm-pits, behind the ears, &c. The matter of perspiration consists chiefly of a watery fluid, containing, in solution, a little saline matter, and commonly mixed with the fluid from the sebaceous glands. It appears to be formed by the exhalant vessels of the *corion*.

Anatomists have generally described a membrane, called the *mucous net-work, (rete mucosum,)* as being always found between the cuticle and true skin; and it is certain, that in negroes, mulattos, and probably other persons with dark skins, that such a membrane is capable of being shewn. This is usually described as a layer of mucous and glairy fluid, of a more or less dark colour; and, from its lying immediately above the reticular portion of the skin, it has often been confounded with this membrane. There seems no doubt, that the apparent colour of the skin in natives of different countries, depends much on the existence or colour of this substance. If, as we

Integumation.

suspect, it be not properly a membrane, but only a layer of mucous matter, secreted by the parts beneath, it may, in certain cases, be absorbed, and thus the dark colour of the skin may disappear. There is now living in Edinburgh, a Bengalee mulatto, about 60 years of age, who was brought to this country 50 years ago. He was then of a very dark colour; but for many years this dark hue has gradually worn away, till at present (June 1816) there remain only a few scattered dark spots, the rest of his skin resembling that of a native European.

The outermost integument of the body in all animals with which we are acquainted, is the *cuticle* or scarf skin. This is an organic insensible membrane, consisting in the human body of two evident layers, possessing little extensibility, and scarcely any elasticity. It is of very different degrees of density or thickness in different parts of the body; a circumstance which depends much on the greater or less pressure to which it is exposed. In the palms of the hands, and soles of the feet, it is extremely thick, whereas on the lips, nipples, &c. it is thin and delicate. When thick, it is composed of several layers which occasionally peel off from each other. When a part is excoriated or deprived of its cuticle, this membrane is, in general, speedily reproduced.

The outer layer of the cuticle is composed of scales lying over each other, with openings or pores between them that probably communicate with the pores of the corion. These scales are in some places so arranged as to form curved parallel lines, an appearance very evident at the points of the fingers. Its inner layer has more of a reticulated than scaly appearance, and probably has often been mistaken for the *mucous net-work*. The cuticle is naturally white, and nearly transparent. It is capable of being raised from the parts beneath by scalding fluids, or by the action of blisters; and, in these cases, the raised portion is destroyed, and a new one produced. The origin of the cuticle has not been satisfactorily ascertained. It appears to be inorganic, as no vessels can be traced communicating between it and the skin. Small filaments, indeed, have been described as passing from the skin to this membrane; but if these were of a vascular nature, it is not probable that the extensive separation of cuticle, which is sometimes the consequence of vesication, could easily take place. It is by some supposed to be an exudation from the skin, that hardens on exposure to the air; and this supposition is rendered probable by what takes place in some of the inferior animals that cast their cuticle.

The common appendages to the cuticle, in the human species, are the *hair* and *nails*; though, perhaps, the former cannot strictly be regarded as an appendage of the cuticle, as it appears to originate in the cellular membrane below the skin, and passes through the pores of the skin and cuticle, receiving an investing membrane from the latter.

Hair.—The structure of the hair is very curious. It rises from a sort of bulb within the cellular membrane, and, as it passes thence to the cuticle, each particular hair is enveloped in a small membranous transparent cylindrical tube, perfectly distinct from the hair itself. It has been supposed that the hair is invested by productions from the cuticle to its farthest extremity; but, though this supposition is carried too far, the sheaths formed from the cuticle are of considerable length. These sheaths are always of a white colour, and transparent, so that the real colour of the hair is seen through them. The hair itself, though possessed of no sensibility, has, from its growth, been regarded as a vascular body; and we know, that in a certain disease, (*Plica polonica*,) it becomes so extremely vascular as to bleed on being cut. The growth of the hair always proceeds from the roots. Except in particular constitutions, and in old age, hair that falls off during disease is generally renewed; but if it be torn up by the root it never grows again.

When a single hair is examined, it is found to possess a slight degree of extensibility and contractility, and, considering its size, it is very strong. When drawn between the fingers, its outer surface appears quite smooth, and even if drawn from root to point, but rough in the contrary direction, which is found to be owing to small conical scales lying over each other, so that their attachments are towards the root of the hair that form the cuticular coat. Hair is found to contain a considerable quantity of oil.

Nails.—That the nails are truly appendages of the cuticle appears evident, both from the circumstance that they are sometimes separated together with this membrane, and that they are similar in texture, though of a firmer consistence. They are distinguished into three parts; one forming about a sixth of the whole, constituting the root, and closely attached to the cuticle; a second forming their outer edge, distinguished from the rest by its colour being properly whiter than the rest; and a third portion, of considerable breadth, forming the body of the nail. The root of the nail is fixed between two plates of cuticle, or rather it is covered by a fold of the skin and a portion of cuticle on its convex surface, and is lined with cuticle within, while the concave surface of the middle portion lies over the skin, to which it is firmly attached by a very delicate membrane that is usually regarded as a reflection of the cuticle. If the nails are suffered to grow, they gradually turn round over the points of the fingers, and diminish the delicacy of the sense of touch.

In their intimate structure the nails are composed of several layers, the number of which is greatest next the root, so that the nail is thickest at this part. On their external surface they are longitudinally streaked.

The nails appear to possess neither vessels nor nerves, and are of themselves insensible; but the skin which they cover possesses acute sensibility, and hence any injury done to the middle portion of the nail excites considerable pain. The nails, like the hair, grow from the roots.

The comparative anatomy of the integuments respects chiefly the skin, the mucous net-work, the cuticle and its appendages.

The texture of the skin is nearly the same in all the vertebral animals as in man, differing principally in thickness and in its degree of attachment to the subjacent muscles. In general its thickness is in proportion to the size of the animal.

Among quadrupeds, therefore, the skin is thickest in the elephant, rhinoceros, walruss, horse, and ox tribes, and it is generally thicker on the back than the lower part of the body. In most of these animals it is closely attached to the muscles beneath, especially to the fleshy pannicle; but in a few instances, as the sloth, the badger, and the honey-weasel, its attachments are but few. It often happens that some of the outer cavities in quadrupeds are tinged of a beautiful colour, as the nostrils in some species of the ape, and the inside of the external ear in the fennec. This is supposed to be owing to their mucous net-work being thus coloured. Otherwise, this part, where it is found, resembles the same substance in the human body.

The cuticle of quadrupeds is of a thickness proportional to that of the skin, and in the larger animals is often marked on its surface with numerous furrows, or wrinkled into remarkable folds. In some instances, as the manes, or scaly lizards, and armadillos, it is composed of hard and firm scales, in the latter tribe resembling shell; and in several other animals which make much use of their tail in laying hold of objects, this organ is covered with a scaly cuticle.

The *hair* of quadrupeds resembles that of man in its general structure. When very coarse it takes the name of *bristles*, and when very fine it constitutes the *fur* or *wool* of an animal. All quadrupeds appear to have a covering of hair; but in a few instances, as the elephant, the rhinoceros, and the walruss, the hairs are few and thinly scattered. The strong hairs that constitute the bristles of hogs, the manes and tails of horses, and the whiskers of seals and other animals, seem to be permanent; but the softer hair is generally shed or cast once a year.

Along with the hair some quadrupeds have spines, as the hedge-hog, or quills as the porcupine, both of which partake of the nature of horn. In the former animals they are fixed, and therefore are properly appendages of the cuticle; in the latter they are so loosely attached as to fall out on violent exertion of the animal, and are commonly cast by moulting.

The nails of apes and lemurs, the claws of bats, sloths, and ant-eaters, manes, dogs, cats, and other beasts of prey, bears and badgers, opossums, kangaroos, beavers, cavies, rats and mice, marmots, squirrels, jerboas, dormice, hares, and rabbits, and the hoofs of the rhinoceros, elephant, camels, musks, deer, antelopes, goats, sheep, cattle, horses, the hippopotamus, the tapir, and hogs, all partake of the nature of the human nails, except that they are of a firmer consistence, and especially the hoofs are composed of a great number of layers. They are all attached to the last joints of the toes, and grow from the roots outwards.

The horns of quadrupeds are of two different natures. Some, as those of the rhinoceros, antelopes, goats, sheep, and cattle, resemble, in their anatomical structure and chemical properties, the nails and claws. They are generally of a conical form, with a broad basis next their attachment to the cuticle; and in many cases they are formed upon a bony mould, which constitutes their internal support, and from which they may be separated by boiling or maceration.

The second kind of horns are long, as those of deers and the giraffe, but in the former tribe they are cast and renewed every year, while in the latter they are permanent, and are real processes from the frontal bone.

In cetaceous animals the outer surface of the skin is extremely villous, and the papillæ are soft, elastic, vascular, and often of considerable length. The skin of these animals is very thick, possesses but little elasticity, and is, in general, tensely stretched over the surface of the body.

The mucous net-work in these animals is very apparent, and much thicker than in quadrupeds. As in other animals, it is of various colours, which, shining through the transparent cuticle, distinguish the colour of the animal.

The cuticle of cetaceous animals is a dense, tough, inelastic substance, composed of several layers, smooth and shining on its outer surface, but rough and resembling coarse velvet within. It is entirely without hair or scales, but is pierced with numerous large holes through which exude oil from the blubber, and mucus from the glands of the skin, to lubricate the outer surface of the cuticle.

There is nothing remarkable in the skin or cuticle of *birds;* but their appendages, viz. feathers, down-hair, beaks, and spurs, merit attention. All birds are covered with feathers, but they do not in all species extend over the whole body. Thus the neck of the vulture, and the legs of wading birds, are bare of feathers; while in the owl, and some varieties of poultry, the feet are covered to the very claws. In a few water-birds, as the penguins, the wings are covered with scales rather than with feathers.

The structure of feathers is extremely curious. At first they appear like small hairs, growing from a bulbous root, within a small, black, cylindrical tube. By degrees they assume the appearance of down, and progressively that of feathers. The feathers appear first on the wings and tail, and the quills are the last in being developed. The shaft of the quills is at first a gelatinous cylinder, with a hard, conical point, and containing blood-vessels. It is covered with a layer of black matter, which gradually splits and forms the barbs.

All *birds* change their feathers once a year by moulting, and the feathers fall off successively.

Both down and feathers are composed of a shaft and barbs, but the texture of both is finer in the former. Intermixed with these, especially in old birds, there is commonly a few scattered hairs, scarcely differing from that of quadrupeds.

The beaks, claws, and spurs of birds, are composed of a horny substance, resembling the analagous parts of quadrupeds. The spurs are supported upon a central bone, similar to that within the horns of cattle.

The structure of the skin in *reptiles* differs but little from that in the preceding classes, except that in some tribes, as frogs and toads, it adheres to the parts beneath only at a few points, so as to form

Integumation

round the animal a sort of loose bag, capable of occasional inflation. The lizards and similar tribes have generally numerous and strong subcutaneous muscles, between which and the skin there is an intimate connexion. This structure is most remarkable in the tail.

There are several diversities in the cuticle of reptiles, and especially in its appendages. In the turtles and tortoises the whole body is covered with cuticle, which is soft and delicate, except on the head, tail, and legs, where it is more or less scaly; but what is most remarkable in those animals is, the shell with which they are enveloped. This is generally a strong and hard horny substance, forming two principal divisions, one called the shield, covering the back, and another, the breast-plate, covering the whole lower part of the body. The former is more or less convex, the latter flat, and sometimes a little concave. Each is composed of numerous pieces, or plates, of which those on the shield are most deserving of attention. They are angular pieces of horn, joined together at the edges, sometimes in a smooth and even manner, and sometimes so as to overlap each other. These plates, in some species of turtle, constitute what is commonly called tortoise or turtle-shell. This whole shelly covering is invested with a thin and delicate cuticle.

Most reptiles have their toes furnished with claws, similar to those of quadrupeds; but the most remarkable appendage to the cuticle, in these tribes, is the scales with which most of them are covered. These, in some instances, as the crocodiles, consist of strong broad plates, of almost a metallic hardness, while in others, as some of the lizards, they are soft and delicate. The scales are also covered with a cuticle.

The cuticle of frogs and toads is generally smooth and slimy, but in some species it is raised into numerous tubercles or warts.

All reptiles, except turtles and tortoises, change the cuticle once a year. In most instances the cuticle is detached in separate scales, or pieces, till the whole is thrown off.

The integuments of serpents resemble those of the lizard tribes in reptiles, except that the subcutaneous muscles are more numerous. They, too, change their cuticle, but in them it is generally sloughed off whole.

The integuments of *fishes* resemble those of the smaller cetaceous animals, except that they are proportionally thinner, have in general but little fat, and the cuticle is covered with scales. It is probable that they have a distinct *mucous net-work*, to which may be attributed their variety of colours.

Some of the *mollusca* are covered with a naked skin and a smooth slimy cuticle, which is sometimes plaited into folds. The rest of these animals, constituting the *testaceous mollusca*, or shell-fish, are provided with a hard calcareous covering, sometimes in one piece, as the univalve shells, sometimes composed of two or more pieces. These shells are covered with a cuticle, and are capable of being renewed when thrown off, or repaired when injured, by a fresh secretion of calcareous matter from the body of the animal.

Crustaceous animals, as their name imports, are invested with a solid covering of more or less density and hardness, being hardest and thickest in lobsters and crabs. In general its structure resembles that of the shells of *mollusca*, but sometimes it is so thin and elastic as to resemble rather horn than shell.

The integuments of *insects* consist chiefly of a cuticle, which is generally more or less horny, and is frequently covered with hairs or scales. In their *larva*, or caterpillar state, they have a pretty dense skin, with numerous subcutaneous muscles; but this skin is repeatedly thrown off and renewed as the animal increases in size. The body of the *chrysalis* is enclosed in a uniform annular horny covering, which bursts often with considerable violence when the insect assumes its perfect state.

The skin of *worms* is thin and delicate, and, in most instances, well provided with minute subjacent muscles; the cuticle is also thin and transparent in some cases, smooth and slimy in others, covered with protuberances, or clothed with hair. The naked worms appear to cast their skin.

Reproduction.

Chap. VIII. Of Reproduction.

Having now described the several functions which are subservient to the support of animal life, and to the intercourse that takes place between an animal and the external objects by which he is surrounded, it remains only to take a view of that function by which the species is continued, to trace the gradual progress of the young animal, and to explain the circumstances by which it is distinguished from the adult.

Here anatomical description is not necessary, and indeed, in a treatise like the present, it is not intended to teach anatomy as a professional science, but to give such a comprehensive and connected view of the animal economy, as to gratify the laudable curiosity of the general reader, and admirer of nature's works. An abundant field for physiological inquiry, on the subjects of the present chapter, opens, without entering on descriptions that can be useful only to the medical practitioner, and which cannot be interesting unless they are minute.

A difference of sex prevails in all the vertebral animals; but in many of the *invertebral* classes, either the sexes are confounded, or there are no external organs.

In the human species, those glands which form the principal preparative organs of reproduction are composed chiefly of numerous ramifications of arteries and veins, forming convolutions, and connected with numerous small tubes which act as secretory ducts, and these tubes at length unite in a common canal, which, after a very tortuous winding course, enters the *pelvis*, and opens into what is called the bulb of the urethra. These organs are properly internal in the *fœtus*, and become external only a short time before birth, sometimes not till considerably after that period. Then they are enveloped each in its own membranes, though contained in a common receptacle.

Of the female reproductive organs the most material are the *uterus* and its appendages. The uterus is a triangular cavity situated in the lower part of the pelvis, between the bladder and the rectum, and retained in that situation by numerous ligaments and surrounding cellular substance. In the unimpregnated state it scarcely exceeds three inches in length, by

Reproduction.

about two at its broadest part, and its internal cavity is so small that it would with difficulty contain a large hazel nut. In shape this organ resembles a pear; its sides are thick, fleshy, and vascular, and capable of very considerable extension both in length and thickness in consequence of impregnation.

Connected with the *uterus*, on each side, lies an oval body called *ovary*, as containing the *ova*, or rudiments of the fœtus, and between each of the ovaries and the uterus there is a tube of communication, by which the *ova* from the former are conveyed into the latter.

When an *ovum* is thus detached from the *ovary*, and received into the *uterus*, it is soon attached to one side, gradually becomes enveloped with peculiar membranes, and surrounded by a fluid. The gradual developement of the *fœtus* during pregnancy is extremely curious. About four weeks after conception the embryo is not larger than a common fly, of a soft mucilaginous consistence, without extremities, but having the rudiments of intestines covered by a transparent membrane, a moving point that is to form the future heart, and an evident head, with two black dots in the place of eyes. It appears suspended by the belly, and attached to the *uterus* by a slender cord. In a fortnight more its size increases to that of a small bee, its consistence grows firmer, and the rudiments of the extremities begin to make their appearance. At the end of three months its shape is tolerably distinct, and it is about three inches long. At four months, it is about five inches long, and its motions begin to affect the mother. By six months it has acquired the length of nine inches; and in one month more it is in general capable, if expelled from the *uterus*, of being kept alive and nourished.

A *foetus* of eight months has the following peculiarities. Its bones are soft and cartilaginous; their protuberances form distinct portions, and, in particular, the bones of the head, are soft, yielding, and not all united to each other, especially the frontal and parietal bones, between which there long remains an unossified space, called the opening of the head. The head itself, and consequently the brain, is much larger in proportion to the rest of the body than at any future period. The muscles are soft, white, and flaccid, the spinal marrow and nerves proportionally large, the nose broad and flat, the external auditory passage imperfect and cartilaginous, the eye large and protuberant, the mouth small and without teeth.

The heart, and large blood-vessels in immediate connexion with it, present several important differences in the *fœtus*. There is an oval hole in the partition between the right and left auricles, provided with a valve so situated as to permit part of the blood from the right auricle to flow into the left, while it prevents any from flowing in a contrary direction. There is also between the right and left arteries a large canal forming a complete communication between them, so that most of the blood from the right ventricle flows directly into the aorta, and a very small quantity is transmitted to the lungs.

Hence the lungs of the *fœtus* are smaller, firmer, and of a darker colour than those of a child after birth. Indeed they much resemble the liver in consistence, and like it sink in water. In the upper and fore part of the chest, between the folds of the mediastinum, there is found in the *fœtus* a large glandular body called the *thymus gland*, the use of which is not certainly known, though it is supposed to be connected with the nutrition of the fœtus.

The *liver* in the fœtus is very large, and its two principal lobes are nearly of equal size. From it there pass blood-vessels through the navel of the *fœtus*, to and from that vascular mass called the *placenta*, by which it is connected with the *uterus*. The vessels are enveloped by integuments, and form what is called the *umbilical* cord or navel string.

From what has now been said, it appears that the circulation of the *fœtus* before birth differs in several respects from that of the child after birth. It proceeds as follows. The *fœtus* is in the first place supplied with blood from the mother through the medium of the placenta, from which it is conveyed through the umbilical vein to the liver. Hence one part of the blood, without entering the liver, is carried off by a branch of the umbilical vein, and through a neighbouring branch of one of the hepatic veins, into the great ascending *vena cava*, while the rest of the blood circulates through the liver by the ramifications of the venæ portæ, and is thence also carried into the ascending vena cava. The blood from the placenta and the blood from the liver are conveyed into the right auricle, whence part of it is sent through the oval hole into the left auricle, while the rest passes into the right ventricle, by the contraction of which it is propelled into the root of the pulmonic artery; but on account of the large communication between this and the aorta, most of it passes immediately into this latter vessel, while a small portion is sent to nourish the lungs, whence it is brought to the left auricle of the heart, from which it passes into the left ventricle, and is propelled into the *aorta*. Now, while part of the blood is sent through the system by the ramifications of the aorta, another part is carried aside by the *internal iliac arteries* through the two umbilical arteries, and along the umbilical cord to the *placenta*, whence it is brought back and circulated as before.

The natural food of an infant for some months after birth is the milk secreted in the breasts of its mother. These glands are situated between the integuments and the pectoral muscles, to which latter they are attached chiefly by cellular substance and fat, and the breasts contain a quantity of fatty matter in their composition. The proper glandular part consists of several lobes that are extremely vascular, and are well supplied with nerves and absorbents. The principal secreting part is composed of a great number of small tubes, called lactiferous ducts, which appear to originate in the extremities of the arteries, gradually uniting into trunks, and passing in a radiated manner from each lobe to the base of the nipple. Here they are usually coiled up in a spiral form, though capable of being distended when the nipple is drawn out. They form from twelve to eighteen orifices opening on the surface of the nipple.

The milk of the human female differs from that of the cow chiefly in three circumstances; in having a greater quantity of oily matter, which cannot easily be separated from the curd; in containing much less

Reproduction.

curdy matter in its serous part; and in containing a greater quantity of saccharine matter.

Without adverting to the usual sexual distinctions, here we may notice the general differences that distinguish the male and female of the human species. These differences have been remarked in almost every part of the organization. Thus the whole female skeleton is said to be generally smaller than that of a male of the same age; the head, hands, and feet, proportionally smaller; the neck longer; the lower extremities shorter; the *pelvis* more capacious; and the prominences of the bones less remarkable. The muscles are also in general smaller and more flaccid; the ball of the eye proportionally smaller, its coats and membranes thinner; the skin of the eye-lids of a lighter colour and less wrinkled; the arch of the eye-brows less prominent; the eye-brows themselves finer and thinner; the aperture between the eye-lids when the upper lid is raised smaller and narrower, and the corners of the eye more acute. The larynx is smaller in women than in men in the proportion of nearly one-half, and the angular projection of the *thyroid cartilage* is much flatter in the former. The integuments in general, are thinner, softer, and less hairy.

The preparatory glands of quadrupeds in their intimate structure resemble those of man; but in many tribes and species they are rather internal than external, being concealed within the belly.

The *uterus* of female quadrupeds differs considerably in form and composition. In apes and lemurs it is a single cavity of a pyramidal or oval form. In bats, in the dog tribe, the seal, the hedgehog, the mare, and cow, the principal cavity is also single, but there are connected with it two tubular openings or horns, which in some tribes are convoluted towards their remote extremities. A third class of quadrupeds has the uterus partly double, or provided with capacious horns, as the hare tribe; and a fourth, as the opossums and kangaroos, have it double through its whole extent. The sides of the uterus in quadrupeds are much thinner, and more membranous, than in the human species.

Some quadrupeds, as kangaroos, and some of the opossums, have a sort of supplemental uterus, into which the young are received immediately after birth, and where they are sheltered and nourished till they are capable of sustaining the injuries of the weather. This is called the *abdominal pouch*, and consists of a cavity formed by a fold in the integuments of the belly, and provided with an external opening, capable of being more or less contracted by appropriate muscles, and enclosing the dug and teats.

The dugs or *mammæ* of quadrupeds differ from the breasts of women in most tribes. In apes and bats indeed they are situated on the breast, but in most other quadrupeds in the posterior part of the belly, or the teats are arranged along the belly in two rows. It is generally supposed that the females of quadrupeds have twice as many teats as the number of young which they usually produce, a rule to which, however, there are several exceptions. The teats of quadrupeds differ from the nipple of the human breast in having a single large tubular opening for the passage of the milk.

The time of *utero-gestation*, or the period of pregnancy in female quadrupeds, is extremely various, though in general proportional to their size. Thus the squirrel, rat, ferret, and probably the guinea-pig, go with young about six weeks; the fox about the same period; the hare and rabbit about a month; the cat eight weeks; the bitch and otter nine weeks; the wolf rather more than three months; the sow four months; the ewe and hind five months; the rein-deer eight months; the cow and arctic walrus nine months; the mare eleven months; the camel twelve months; and the elephant twenty-one months.

The usual number of young produced at a birth, by various species of quadrupeds, as far as it has been distinctly ascertained, is as follows. The sloth, rhinoceros, elephant, walrus, camel, hind, cow, and mare, usually produce one; the ape, seal, porcupine, rein-deer, she-goat, usually two; bats from two to five; the bitch, fox, wolf, lioness, tigress, cat, otter, Virginian opossum, mole, squirrel, hare, produce four, five, or six; the jackal, ferret, guinea-pig, mouse, rabbit, from eight to ten, or sometimes twelve; and the rat and sow from ten to eighteen or twenty.

The reproductive organs of cetaceous animals nearly resemble those of ruminating quadrupeds; but, from the peculiar form of these animals, the situation of these organs is a little different. The milk of the female is said to resemble that of the cow, but to be rather richer. Their period of gestation is not exactly known, but it is supposed that the female goes with young about ten months. They generally produce only one at a birth, which they suckle for about a year.

This function in birds offers several peculiarities both in organization and phenomena. The seminal glands lie within the belly, near the kidneys, and their excretory ducts terminate near the rectum in a dilated part. In both sexes the external organs are situated within that cavity we have already described as common to these organs and the extremity of the intestines, and called *cloaca*. There is in birds a single ovary, situated near the liver, and generally consisting of numerous, round, yellow bodies, contained each within its own membrane, and forming the future yolks of the eggs. With the ovary is connected a membranous, expanded tube, from which arises another membranous tube, long and convoluted, called the oviduct. This is susceptible of considerable dilatation, and terminates in an expanded portion, connected with the cloaca by a short tube, contracted in the usual state of the animal, but easily dilatable. The rudiment of the egg is first extricated from the membrane that contains it in the ovary, and is received by the first expanded portion, where it is completed as a yolk. Hence it passes into the oviduct, where it remains till it has acquired its white and shell, after which it is gradually propelled into the cloaca.

The period of incubation, or the time during which a hen-bird sits on her eggs, varies in the different species. Thus the humming-bird sits twelve days; the canary-bird, black-bird, wren, and pigeon, a fortnight; the hen three weeks; the duck, goose, turkey, and eagle, about a month; and the swan and ostrich about six weeks.

The *general structure of a bird's egg* is familiar to

Reproduction.

every one; but it may be proper to mention the names by which physiologists have distinguished its several parts. The skin lining the shell is called the membrane of the *albumen*, or white of the egg. Within this are two whites, of which the inner surrounds the yolk, enveloped in a peculiar delicate membrane, called the *yolk-bag*. From the two opposite sides of this bag there extend two white, knotty bodies, called *chalazæ*, terminating in the white of the egg by a flocculent extremity. On the surface of the yolk-bag, there is a small, white, round spot, commonly called traddle, surrounded by one or more whitish concentric circles, called *halones*. The use of these latter parts is not known.

The progress of the chick during incubation has been minutely examined in the common domestic fowl, and is as follows. At the end of the first day, there is perceived, near the traddle, a small shining spot, of an oblong form, with rounded extremities, and narrowest in the middle. On the second day this has acquired a curved form, and resembles a gelatinous filament, closely surrounded by a peculiar membrane, and there is a slight appearance of red vessels on the surface of the yolk-bag. On the third day the heart is observed to pulsate. It resembles a convoluted canal, consisting of three dilated portions, lying close together in the figure of a triangle, and forming the rudiments of an auricle, a ventricle, and an artery. About the same time the vertebral column of the chick is observable, of a crooked form, and the rudiments of the eyes appear. By the fourth day the chicken is nearly half an inch long, and the stomach, bowels, and liver, are discernible, and a vascular membrane forms about the navel, from which it extends within the membrane of the *albumen*, covering nearly the whole inner surface of the shell. The lungs are also apparent, but respiration is not yet properly begun. By the sixth day the chick is about seven lines long, and begins to shew signs of motion. On the ninth day ossification commences, and several bony points appear, especially round the edge of the sclerotic coat of the eye, which then resembles a circular row of pearls. By this time elegant yellow vessels begin to appear on the surface of the yolk-bag. On the fourteenth day the rudiments of the feathers are visible about the wings, and the chick opens its mouth for air, if taken from the shell. On the nineteenth day it is capable of uttering sounds; and on the twenty-first it quits its prison.

In *reptiles*, the seminal glands are also internal organs, and are situated, as in birds, near the kidneys. In the males of some of these animals, there are hard, brown, or blackish tubercles attached to the thumb and palm of the fore feet, which are most visible during the pairing season. This structure is found in frogs and toads. The female organs resemble those of birds, except that in some species, as turtles and tortoises, there are two ovaries. In the female of one species of toad, the pipa, or Surinam toad, there are numerous hollow cells in the back of the animal, in which the ova are placed by the male after being fecundated, and where they remain shut up, by the skin contracting round them, till they are capable of maintaining a separate existence.

All reptiles, like birds, are *oviparous*, though in the salamander the eggs remain in the oviduct till hatched. The eggs of turtles, tortoises, and the several varieties of lizards, nearly resemble those of birds, but are of a rounder form, and are often covered with a membrane resembling parchment, instead of a calcareous shell. The eggs of frogs and toads are gelatinous, and connected together like a twisted string of beads.

The progress of the young animal in some of the reptile tribes is not less curious than that of the *fœtus* or the chicken, especially in the frog and toad tribes, the young of which is called a tadpole, and undergoes several remarkable changes. When first extruded, there is only a small dark speck in the centre of the gelatinous *ovum*, which in two days is a little enlarged, but still retains a spherical form. In four days, this central spot resembles a small kidney-bean, and in one day more has assumed the shape of a half crescent. On the sixth day it has increased in length and thickness, and become straighter, and the distinction of head and tail, with the rudiments of eyes and mouth, is visible. By the seventh day this distinction is more evident, and there are visible the rudiments of feet and gills. The tadpole has now increased considerably, and quits the egg. About the ninth day the head and body are enlarged, and the tail increased in length. From this time to the twentieth day, the gills are very evident, but by the latter period are withdrawn below the skin. Hitherto the tadpole has had only the hinder legs, but by the twenty-fourth day the fore-legs begin to make their appearance. The body of the little animal is still transparent, and the bowels are distinctly seen through the integuments. The tail also still continues, but in a few days gradually disappears. In about two months all the legs are developed, and the animal becomes a perfect frog.

No reptile, if perhaps we may except the salamander, hatches her eggs, but buries them in the sand or earth, or drops them in the waters, to be hatched by the genial heat of the sun.

The organs and phenomena of reproduction in the *serpent tribes*, so nearly resemble those of most reptiles as not to require a separate examination.

The principal male organs of *fishes* constitute what in the bony fishes is called the *soft roe*, consisting of two long flat bodies, of a white colour, and an irregular outer surface, but soft and pulpy within, having an excretory duct passing through the middle of each, and terminating at the back part of the *rectum*. These bodies are situated beside the intestines, and the left lobe surrounds the rectum. In the cartilaginous fishes these glands more resemble those of the warm-blooded animals in their granular texture, though still of a soft consistence.

The hard roe of female fishes is also different in the bony and cartilaginous fishes; in the former it consists of two long bodies, resembling in form the soft roe of the male, but of a much firmer consistence, and fitted with a prodigious number of globular eggs. These eggs are so numerous, that, in a carp not more than eighteen inches long, there have been counted 350,000. The two parts of the roe are enveloped in distinct membranes, till they approach the *anus*, where they unite by a common tube. In the carti-

Reproduction.

laginous fishes, the female roes resemble the ovaries of birds and reptiles, and the *ova* are like yolks, of no inconsiderable size. There is also in these fishes a double oviduct, uniting as it terminates in a *cloaca*.

It is well known that fishes at certain seasons shed the *ova*, or *spawn* as it is called, from their roes, and leave it to be hatched in the waters.

The seminal glands of *mollusca* generally resemble the soft roe of bony fishes, but contain a number of small tubes, which are expelled by the animal in an entire state. In snails and slugs these tubes resemble little darts, which the animals, for these species are hermaphrodites, shoot at each other.

Most mollusca, however, are male and female, and the female contain the ovaries. The eggs extruded from these ovaries are in some species, as the cuttle-fish, united together, so as to resemble a bunch of grapes.

Crustaceous animals have generally a distinction of sex. Thus, in crabs, the male is distinguished from the female by the smallness and narrowness of his tail, which, in the latter, is long and broad, and provided with numerous fimbriated appendages for retaining the spawn. In the female crab there are two transparent membranes below the middle of the tail, communicating with the parts within. In many of the *insect tribes* there are three genders, males, females, and neuters. In the first the seminal glands are often remarkable for their size and the convolutions of their vessels; and the ovaries of the female insects sometimes increase to such a degree before the eggs are extruded, as to render the animal's belly many times larger than its ordinary size.

Most insects undergo two changes before coming to the perfect state. When the egg is hatched, it produces a caterpillar or maggot, which is called the *larva* of the insect, generally having numerous legs, and jaws capable of cutting and tearing. This *larva* gradually increases, occasionally changing its skin, till it has attained its full size in that state. It then gives over eating, generally spins a web around it, or contracts its body, and becomes covered with a horny coat; it is now a *chrysalis*, or nymph, and remains in a state of apparent torpidity till the season arrives for its assuming the perfect state, when it bursts its shell and appears a winged insect.

Several of the *worms*, as leeches, earth-worms, and a few others, are hermaphrodites, and mutually impregnate each other. With respect to others, especially the intestinal worms, there is a difference of opinion; some authors considering them as male and female, while others seem to regard them as hermaphrodites.

Some *zoophytes*, as sea-urchins and star-fish, have evidently ovaries, which, at certain seasons, form a very conspicuous part of their structure; but in general the animals of this class have no generative organs, and reproduction in them takes place by sprouts or buds that form on the body of the parent animal, and, on being detached, are gradually developed into the form and dimensions of their parent.

Chap. IX. Of Death.

Of Death.

The functions considered in the preceding chapter gradually decay as old age advances, and at length cease altogether. This cessation of the functions, independently of accident or disease, constitutes natural death,—an occurrence which, in the present state of society, is by no means common.

The approach of natural death is slow and gradual. The external functions cease one after another; all the senses are successively lost, or the ordinary causes of sensation pass over them without making their usual impressions. The eye becomes obscure and dim, and its humours at length no longer transmit the images of objects to the retina. Sounds strike upon the ear confusedly, and this organ soon becomes entirely insensible to them. The integuments grow hard and horny, and, many of their vessels being gradually obliterated, exercise the sense of touch in an obscure and indistinct manner. All the organs dependant on the skin become weak and decay; the hair and beard grow white, and, deprived of the juices which should nourish them, the hairs of the head gradually fall off. Odours are no longer perceived by the nose, or they are perceived but faintly. Tasting usually survives the rest of the external senses; but that, too, at length becomes imperfect or depraved.

The functions of the brain partake of the imbecility of the external senses; the memory no longer retains those occurrences which are every day taking place, though it long recals those of past times with relish and delight; the imagination becomes dull and often depraved, the judgment weak and wavering.

As the animal functions intimately depend on the nervous system for their vigour and activity, it is to be expected that the former must be enfeebled as the latter decays. Locomotion becomes difficult and painful; the body totters at every step; the voice grows weak; the tongue faulters, and articulation is indistinct. Circulation and respiration diminish in frequency and vigour; the appetite is in general less keen and less frequently excited; digestion languishes; many of the secretions no longer take place; the circulation in the minute vessels, from the diminished energy of the heart and larger arteries, gradually ceases; the heart at length is unable to propel the blood from its ventricles; the circulation through the lungs being thus arrested, these organs cease to inspire, make their last expiration, and terminate the life of the animal.

Thus, in natural death, the brain may be said to die first, and the heart and lungs last; but in violent or accidental death, life may cease in either of these latter organs, before it ceases in the brain. The action of this last may be completely impeded, and circulation and respiration may continue for a considerable time; but, in general, when the action of the heart is suddenly obstructed, as by a wound, or the lungs overwhelmed, as in cases of suffocation, the death of the brain soon follows.

The usual signs of approaching death are, a quick, small, indistinct and intermitting pulse, coldness and clamminess about the extremities, dimness and hollowness of the eyes, collapsed features, an unusual prominence of the bones of the face, a hollowness at the temples, and a sharpness of the nose. The ordinary signs of death having actually taken place, are, the want of respiration, as commonly shewn by the brightness of a mirror held before the mouth remaining undiminished; rigidity of the limbs; complete loss of motion; the collapse, opacity, and insensibility of the eye; the want of pulsation in the heart and arteries; the coldness of the body; the paleness or lividity of the countenance, the relaxation of the lower jaw, the regurgitation of liquids to the mouth; the insensibility of the membrane of the nostrils; the collapse, paleness, and wrinkling of the lips; and, lastly, putrefaction. Of all these, however, the last is the most certain and indubitable.

Few circumstances can be conceived more humiliating to the pride of man than the changes produced on his frame by death. Let us, for example, contemplate a female in the prime of youth and the bloom of health and beauty. Those elegantly rounded and finely formed limbs, that graceful flexibility of movement, that gentle warmth, those cheeks crimsoned with the roses of delight, those eyes brilliant with the spark of love or the fire of genius, that countenance enlivened by the sallies of wit, or animated by the glow of passion, altogether seem united to form a most enchanting being. A very short time suffices to destroy the illusion. Often, without any apparent cause, motion and sensation cease, the body loses its heat, the muscles collapse and disclose the angular prominences of the bones, the eyes lose their lustre, the cheeks and lips acquire a livid hue. These are but preludes to changes still more disgusting. The flesh becomes successively blue, green, black, and attracts humidity; and while one portion evaporates in infectious effluvia, another dissolves into a putrid sanies, which, ere long, is also dissipated. In a word, after but a short lapse of time, there remain only a few earthy or saline principles. The other component elements of the body have mingled with the air of the atmosphere, and are destined to enter into new combinations.

On the *particular* cause of death, it is not the business of this treatise to enter, and the general *immediate* cause is involved in much obscurity. It has generally been attributed to the increased rigidity of the animal fibre; but this alone is insufficient to account for the change produced. In our investigations concerning the cause of death, as with respect to the causes of many other natural phenomena, we reason in the dark; and, in fact, we can better describe what death is, than point out its immediate or proximate cause.

Chap. X. History of Anatomy and Physiology.

The early history of anatomy and physiology is of course but little known. That mankind had, at a very remote period, some acquaintance with the structure and functions of the human body, and of those animals that were killed in the chace, or offered as sacrifices to the Deity, is reasonably to be inferred from the natural curiosity and observant faculty of man. The field of battle might occasionally exhibit parts of the human skeleton, and extensive wounds might sometimes afford an opportunity of examining the structure and position of some important internal organs.

Among the Egyptians.—As a science, physiology is supposed to have been first cultivated in Egypt, where the pillars of Hermes were inscribed with all the medical knowledge of that people. These inscriptions so completely regulated the practice of medicines that if a practitioner deviated from their rules in the slightest points, and his patient died, he was considered guilty of murder, and subjected to punishment. It has been supposed that the practice of embalming, which was employed among the Egyptians from time immemorial, affords a proof that this people were skilful anatomists. But this operation, as far as it required anatomical skill, was very simple, consisting chiefly in abstracting the brain and contents of the chest and belly, and filling these cavities with resins and spices.

The Greeks.—Scientific anatomy and physiology were early cultivated among the Greeks, as we learn from the writings of Homer, which contain several passages that shew him to have been acquainted with the animal structure.

Democritus, the philosopher of Abdera, contemporary with the great physician Hippocrates, appears to have been one of the earliest dissectors of dead bodies. He is said to have examined several of the inferior animals with a view to discover the nature and seat of the bile, on the morbid state of which he conjectured madness to depend.

Hippocrates, among his numerous writings, has left several chapters on anatomy. He enumerates the bones, and describes their forms, processes, and connexions; he mentions several of the ligaments, particularizes some of the muscles and nerves; he describes the structure and pulsation of the heart, and even speaks of a circle of the blood. He supposed that a native fire resided in the left ventricle of the heart, and that the use of respiration was to cool and moderate this fire, and thereby preserve the equable temperature of the system. This native fire also acted as a vital principle, and regulated all the functions both of mind and body, through the intermediate agency of certain faculties or powers.

The writings of Plato and Aristotle contain the rudiments of the physiology of their times. Plato supposed the heart to be the source of courage and passion, and the liver of desire; the head to be the seat of reason, the chest of strength and anger; and he agreed with Hippocrates in his notion of the use of the lungs as coolers of the body. Aristotle attributed to the soul these faculties which he denominated nutritive, sensitive, and rational; the first being the principle of life, the second the origin of feeling, the third the source of the understanding. This philosopher cultivated comparative anatomy, and in his history of animals frequently adverts to their internal structure. In his general physiology he agrees with Hippocrates.

In the school of philosophy established at Alexandria, Herophilus and Erasistratus were celebrated for their knowledge of the animal economy. They were assiduous dissectors, and, if we may credit the historians of that age, were allowed to dissect alive the bodies of condemned criminals. Herophilus paid great attention to the nervous system, and was well acquainted with the structure of the brain. He is said to have been the first anatomist who employed a human skeleton for teaching osteology. Erasistratus first discovered the valves of the heart, and he suggested the idea that the bile was secreted by the liver. He also seems to have traced the chyle, in its passage through the intestines.

The early anatomists supposed that the arteries contained only air; and it was not till the beginning of the second century of the Christian æra that Rufus Ephesius proved that they contained blood. He supposed, however, that the blood entered the arteries only after death.

Galen, who flourished in the middle of the second century, established a system of physiology, which prevailed in the schools of medicine and philosophy for many ages. He proved that the arteries naturally contain blood; and he was the first to demonstrate that the larynx was the organ of voice; he adopted the principle of Plato, and introduced the notion of temperaments. Of these he supposed there were four, which he denominated, from the humour that prevailed in each, *sanguineous*, *phlegmatic*, *bilious*, and *melancholic*.

Among the moderns.—Modern anatomy and physiology may be said to have originated in the beginning of the fourteenth century with Mundinus, a physician of Milan, who published a regular system of anatomy, which superseded the treatise of Galen; but it was not till after the invention of printing had facilitated the circulation of books, that these sciences began to make any considerable progress.

In the sixteenth century there arose many eminent anatomists, who materially advanced the progress of the science by their original and important discoveries. We may particularise Berengarius of Carpi, professor of Bononia, Charles Stephanus, Fernelius, Andernach, and more especially Vesalius. This last eminent anatomist demonstrated that the blood could not pass immediately through the partition between the ventricles of the heart, as had been suggested by some preceding writers. It was now suspected that there was a communication between the arteries and the veins, though how the blood flowed from the former into the latter was not ascertained. Columbus, the disciple of Vesalius, produced additional proof that the blood flowed from the arteries into the veins in the lungs; and Cæsalpinus, who lived towards the latter end of the sixteenth century, proved that the blood passed from the extremities of the arteries into the extremities of the veins, and that in these latter vessels it *sometimes* flowed from the branches into the trunks. Still, however, he entertained the idea that the blood flowed backwards and forwards from arteries into veins, and from veins into arteries. About the same time, Fabricius of Aquapendente, professor at Padua, discovered the valves of the veins, which had however been observed, though not distinctly marked, by some preceding anatomist. Fabricius had the merit of tracing them fully, and calling the attention of his disciples to their nature and uses.

Circulation of the blood discovered.—One of the disciples of Fabricius was our countryman Harvey, who ardently prosecuted the investigation of the valves in the veins, till he discovered their true use to be impeding the passage of the blood towards the arteries. Thus he shewed, that having entered the veins, the blood must proceed through them towards the heart; and as it was known that the blood flowed in the arteries from trunks to branches, he naturally concluded that there must be a perfect circulation from one side of the heart to the other. Harvey, therefore, is now generally allowed to have been the real discoverer of the circulation of the blood, a discovery which he published to the world in 1628. This important discovery was followed by as important a revolution in the theory of medicine, which will afterwards be noticed.

Absorbent vessels.—The discovery of the circulation of the blood was soon followed by another scarcely less important, that of the absorbent system. The *lacteals* were first observed by Asellius of Pavia, in 1622, in consequence of his opening a living dog. He traced them as far as the mesenteric glands, and gave them the name of lacteals, from the milky colour of the chyle. He thought, however, that they terminated in the liver. Soon after Pecquet, a French anatomist, discovered that the chyle passed to the heart, and observed the thoracic duct. Olaus Rudbeck and Thomas Bartholine, the former a Swedish, and the latter a Danish anatomist, some time after the discoveries just noticed, observed the *lymphatic* vessels, and found that they terminated in the thoracic duct. In 1654, Glisson proved that these lymphatics are absorbents; and in 1664 and 1665 their valvular structure was discovered by Swammerdam and Ruysch.

Van Helmont, &c.—During all this time physiology had been making slow advances. From the time of Arnold of Villa Nova, and Paracelsus, it had been founded almost entirely on chemical or astrological principles, till Van Helmont introduced an intelligent being, called *archæus*, seated in the epigastric region, and having under him several subaltern ministers, situated particularly in the head, chest, and belly, by whom he executed all the animal functions.

The *archæus* of Van Helmont was superseded by the animal spirits of Willis and Descartes; and thenceforward the nervous system, and especially the *pineal gland*, the supposed seat of the soul, became an important object of attention.

Boerhaave, &c.—The metaphysical system of Descartes continued with some modifications till the end of the seventeenth century, when the mechanical philosophers, with Pitcairn and Boerhaave at their head, effected a new revolution. Borelli had some time before shewn how the muscular motions of the animal body might be explained on the principles of mechanics; and his disciple, Bellini, had extended the application of these principles to other functions. The animal body was now likened to a machine, the solid parts of which act according to their figure, bulk, and proportion, and according to the general laws of motion, while the direction, qualities, and effect of the circulating fluid, were subjected to the laws of hydrostatics. In short, every thing in the animal machine was reduced to an assemblage of cords, levers, pulleys, conduits, and canals.

Mechanical physiology was soon, however, modified by Hoffman and Stahl, the former of whom saw the necessity of a mutual action between the solids and the fluids; while the latter, convinced of the insufficiency of mechanical principles alone to explain the phenomena of vitality, strongly and successfully recalled the attention of physiologists to the effects of the *vital principle*, and introduced the theory of a self-preserving action, or what he called the healing power of nature. According to him, every thing in the animal body depends on the union of its organic parts with the active self-preserving principle which governs, according to special laws, those phenomena which may be more particularly termed vital, and which are most independent of the will.

Haller.—Haller improved on the theory of Stahl; and pursuing the route that had been marked out for philosophical inquiries by the immortal Bacon, set himself to collect and arrange the physiological facts that had been already observed. Haller saw the inconvenience of strictly applying the laws of mechanical philosophy to the actions of the living system, and explained the animal motions on the principle of irritability, a power which he considered peculiar to the animal body. To Haller we are indebted for many curious researches respecting the formation of bone, the mechanism of respiration, the action of the nervous system, the structure of the heart, the circulation of the blood, the pulsation of the arteries, and the developement of the *fœtus*. He also cultivated comparative anatomy, which he regarded as of the greatest importance in the improvement of physiology.

Cullen.—The physiology of Cullen is founded chiefly on that of Hoffman, and consists in referring the actions of the animal economy to the movement of the vital solids, as regulated by the fundamental laws of the nervous system. The vital solids, by which are meant the muscular fibres, the blood-vessels and nerves, were all supposed to originate from the last, and to be concentrated in the brain; and all the physical actions of a living being were supposed to depend on the contractility inherent in the moving fibres, excited either by their own extension, by the application of external *stimuli*, or by the immediate action of the nervous fluid.

Hunter.—Cotemporary with Cullen were the two Hunters and the second Monro, all eminent both as anatomists and physiologists. Dr William Hunter improved the anatomy of the absorbent system and that of the gravid uterus. Mr John Hunter added considerably to our knowledge respecting the structure and formation of the teeth, and the nature and properties of the blood, which he supposed to be the immediate seat of vitality. Monro improved both the anatomy and physiology of the nervous and absorbent systems; made several discoveries in the structure of the eye and ear; considerably advanced the study of comparative anatomy, and was among the first to draw the attention of physiologists to the effects of electricity or galvanism on the animal economy.

Brown.—John Brown, at first the disciple and afterwards the rival of Cullen, for some time attracted considerable notice in consequence of a modification of Haller's doctrine of irritability, which he called excitability, and which he considered as the ruling agent that directed all the operations of the animal economy. By the action of stimuli, or exciting powers, the excitability is exhausted. By the abstraction of stimuli, or by rest and sleep, it is accumulated; and on the proper adjustment of the exciting powers, so as to preserve an equable and moderate excitement, depends the healthy state of the animal system. It would be out of place here to detail the doctrines of these medical physiologists, as they must hereafter come under our review in the history of Medicine. It will be sufficient, therefore, to remark, that the theory of Darwin, lately so fashionable in the medical world, is little more than a modification of that of Brown; and that the sensorial power of the former is synonymous with the excitability of the latter.

During the latter half of the eighteenth century, the anatomy of the human body received considerable improvement from the writings of Winslow; Albinus, especially on the bones and muscles; Douglas, chiefly on the muscles; Zinn, on the eye; Sabatier; Soëmmering, on several parts of anatomy, especially the brain, eye, and ear; and Scarpa, chiefly on the nerves, the ear, and the nose.

Of late considerable attention has been paid to Comparative Anatomy. This had been cultivated by Eustachius, Vesalius, Harvey, De Graaf, Blasius, Swammerdam, and Tyson, among the earlier modern anatomists; and in the latter end of the 18th century, by Vicq d'Azyr, Daubenton, Townson, Bonnet, the Hunters, the second Monro, Camper, and Blumenbach. In the present century it has received many important additions and improvements from Cuvier, Dumeril, Lamarck, Lacepede, Macartney, Carlisle, and Sir Everard Home.

Chemistry connected with physiology.—Chemistry holds some share in the physiology of the present day. From the rhapsodies of Paracelsus and his followers, chemical physiology had fallen into disrepute, till it was in some measure revived by Boyle, Mayow, and Hales, in the latter end of the 17th century. The two latter, in particular, pointed out the relation of chemistry to physiology in the function of respiration, and shewed that the pure part of the atmosphere, now called oxygenous gas, and denominated by Mayow the nitro-aerial particles of the atmosphere, performs an important office in the animal economy. Chemical physiology was farther improved by Black, Crawford, Cavendish, Irvine, and Priestley, and still more lately by Lavoisier and the chemists of the French school. Within these few years, however, it was carried to an extreme little less absurd than the doctrines of Paracelsus, by some German chemists, particularly Hufeland, Girtanner, and Humboldt, who, transferring the operations of the laboratory to the animal body, have supposed life to depend on the combinations of oxygen with the vital principle, and on the reciprocal balance of the chemical affinities of all the elements of the animal body. At present, the application of chemistry to physiology is confined chiefly to the functions of digestion and respiration.

Galvanism.—There is one other department of

Fig. 1.

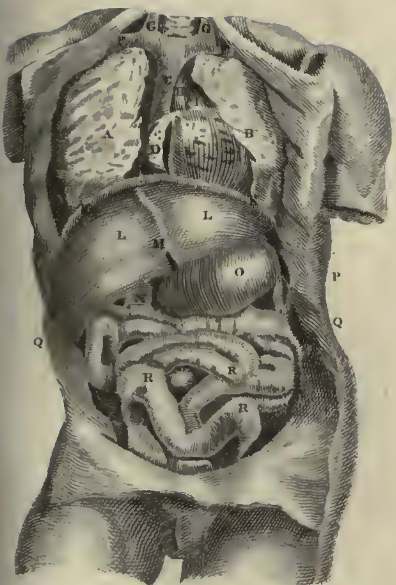


Fig. 2.

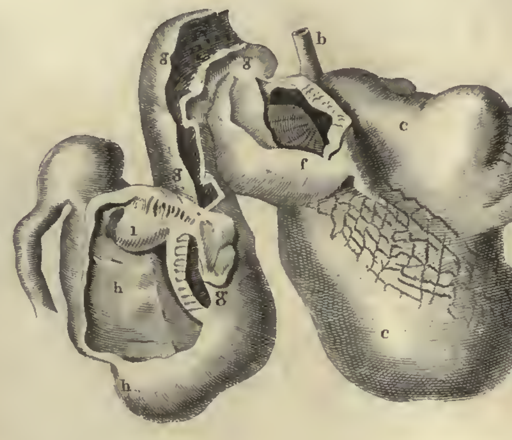


Fig. 3.

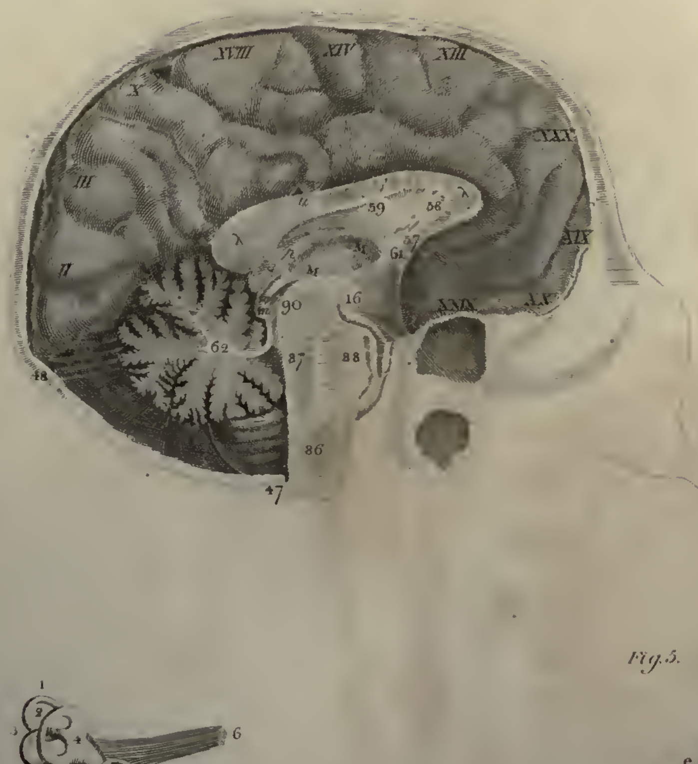


Fig. 4.

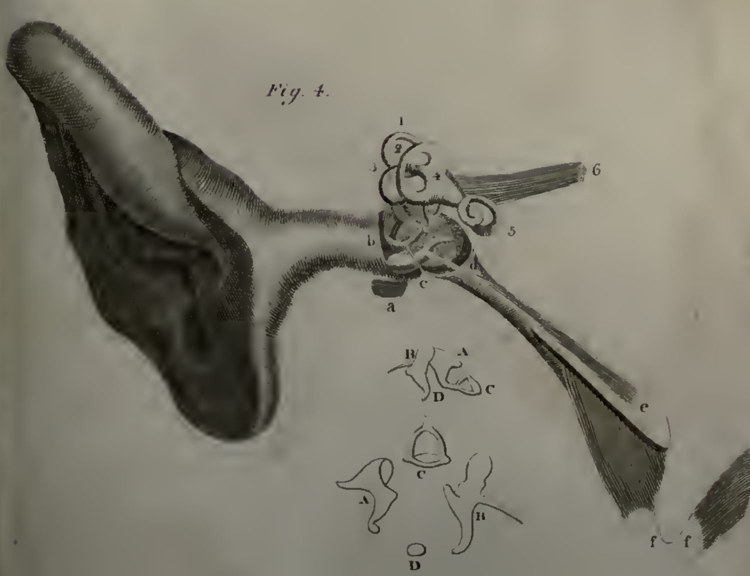


Fig. 5.

History.

natural science, connected partly with mechanical philosophy and partly with chemistry, that has for some time influenced the physiological doctrines of the present day,—we mean animal electricity or Galvanism. The effects of ordinary electricity on the animal body, especially in the concentrated form of lightning, had been long ago observed by Dr Franklin; and Professor Galvani of Bologna having observed convulsive motions to take place in the limbs of a frog, in consequence of its nerve being touched with an instrument in connection with an electrical machine, pursued the inquiry, and discovered that modification of electricity which received its name from him. The effects of Galvanism on the animal system were successively investigated by Valli, Fowler, Robison, Volta, Wells, Humboldt, Aldini, and Ritter.

System of Bichat.—Among the latest systems of physiology, deserving particular notice, is that of Bichat, who divides life into organic and animal, the former being common to all organized beings, plants as well as animals, while the latter is confined to animals alone. Each kind of life comprehends two orders of functions which succeed each other in an inverse series. Thus, in animal life, the first order of functions commences with external objects, and proceeds towards the brain, comprehending motion, voice, external sensation, internal sensation; while the second order begins in the brain with internal sensation, and proceeds externally to voice and motion. In the first order of functions the animal is passive; in the second he is active: through the medium of the first, external objects act upon the body, while, by means of the second, the body reacts on external objects. The functions belonging to organic life are those of digestion, respiration, circulation, absorption, secretion, and reproduction. The brain is the centre of animal life,—the heart, of organic life.

According to Bichat, the proper balance of life is preserved by the due proportion between the action of surrounding bodies, and the reaction of the system. As the reaction is greatest in youth, the vital principle is then predominant, and this principle is defective in old age, as the reaction is then the least. The measure of life, then, is the difference existing between the efforts of external agents to destroy life, and the internal resistance to support it. The excess of the former indicates the weakness of life, that of the latter shews its strength.

Explanation of Plates.

Plate 6.—Fig. 1. A front view of the Skeleton. A, the frontal bone; B, the parietal bone; C, the temporal bone; D, the upper maxillary or jaw-bone; E, the lower jaw-bone; F, the vertebræ of the neck; G, G, the clavicles; H, H, the scapulæ, or shoulder-blades; I, I, the humerus; K, the radius, and L, the ulna, the two bones of the fore-arm; M, the bones of the carpus, or wrist; N, the bones of the hand, or metacarpus; O, the bones of the fingers; P, the sternum, or breast-bone; Q, Q, the ribs; R, the vertebræ of the loins; S, the sacrum; T, T, T, T, the bones of the pelvis; U, U, the femur, or thigh-bone; V, V, the patella, or knee-pan; W, W, the tibia, or large bone of the leg; X, X, the fibula, or small bone of the leg; Y, Y, the os calcis, or heel-bone; Z, Z, the metatarsal and tarsal bones of the toes.

Plates explained.

Fig. 2. Side view of the Human Skull. A, the frontal bone; B, the parietal bone; C, the temporal bone; D, the upper jaw-bone; E, the lower jaw-bone.

Fig. 3. The skull of the Monkey. A, the frontal bone; B, the parietal bone; C, the temporal bone; D, the upper jaw-bone; E, the lower jaw-bone.

Fig. 4. The skull of the Elephant; the most remarkable parts of which are the projections of the jaw-bones. A, is the upper jaw-bone from the projecting part of which, at B, proceed the tusks C; D, is the lower jaw-bone, and the projecting part is at E.

Fig. 5. Is the skull of a species of Hog, the *sus babyroussa*. A, is the frontal bone; B, the upper jaw, from which arise the remarkable tusks D, which are curved backwards and downwards; C, the lower jaw.

Plate 7.—Fig. 1. exhibits a general view of the muscles: 1, is the *triceps extensor cubiti*; 2, the deltoid muscle; 3, the *teres major;* 4, *latissimus dorsi;* 5, pectoral muscle; 6, *obliquus descendens abdominis*; 7, *rectus abdominis*; 8, 8, *sartorius*; 9, 9, *rectus femoris;* 10, 10, *vastus externus;* 11, 11, *vastus internus;* 12, *gastrocnemius;* 13, *solæus;* 14, *tibialis anticus.*

Fig. 2. is a view of the bones of the right hand. The palm of the hand is here represented: *a*, is the radius; *b*, the ulna; *c*, the scaphoid bone of the carpus or wrist; *d*, the lunar bone; *e*, the cuneiform bone, *f*, the pisiform bone; *g*, trapezium; *h*, trapezoides; *i*, capitatum; *k*, unciform bone; *l*, the four metacarpal bones of the fingers; *m*, the first phalanx; *n*, the second phalanx; *o*, the third phalanx; *p*, the metacarpal bone of the thumb; *q*, the first joint; *r*, the second joint.

Fig. 3. is a representation of the palm of the left hand, when the integuments are removed, and the muscles and ligaments of the fingers are brought into view: *a*, tendon of the *flexor carpi radialis; b*, tendon of the *flexor carpi ulnaris; c*, tendons of the *flexor sublimis perforatus, profundus perforans*, and lumbricales; *d*, *abductor pollicis*; *e, e, flexor pollicis longus; f, flexor pollicis brevis; g, palmaris brevis; h*, *abductor* of the little finger; *i*, annular ligament of the carpus; *k, k*, tendons of *flexor digitorum sublimis*, which are perforated by *l, l*, the *flexor digitorum profundus*; *m*, lumbricales; *n*, *adductor* of the thumb.

Fig. 4. is a view of the inferior surface of the bones of the left foot: *a*, the great knob of the heel-bone; *b*, a prominence on its outside; *c*, the hollow for tendons, nerves, and blood-vessels; *d*, the anterior extremity of the heel-bone; *e*, part of the astragalus; *f*, its head covered with cartilage; *g*, the internal prominence of the navicular bone; *h*, the cuboid bone; *i*, the internal cuneiform bone; *k*, the middle, and *l*, the external cuneiform bone; *m*, the metatarsal bones of the lesser toes; *n*, the first, o, the second, and *p*, the third phalanx of the lesser toes; *q*, the metatarsal bone of the great toe; *r*, the first, and *s*, the second joint.

Fig. 5. a view of the upper part of the left foot, shewing the tendons of the muscles of the toes: *a*, the

Plates explained.

cut extremity of the tendo Achillis; *b*, upper part of the astragalus; *c*, heel-bone; *d*, tendon of the *tibialis anticus*; *e*, tendon of the *extensor pollicis longus*; *f*, tendon of the *peronæus brevis*; *g*, tendon of the *flexor digitorum longus*; *h*, *h*, the whole of the *flexor digitorum brevis*.

Plate 8.—Fig. 1. exhibits a view of the viscera of the thorax and abdomen.

A, B, the right and left lungs; C, the heart; D, the right auricle; E, the *vena cava descendens*; F, F, the subclavian veins; G, G, the internal jugular veins; H, the descending aorta; I, the pulmonary artery; K, the anterior edge of the diaphragm; L, L, the two great lobes of the liver; M, the round ligament; N, the gall-bladder; O, the stomach; P, the spleen; Q, Q, some of the large intestines; R, R, the jejunum and ilium.

Fig. 2. which represents the stomachs of the *lama*; *b*, the gullet; *c*, *c*, the paunch; *d*, the cells that appear in two places of this stomach; *f*, the second stomach, or hood; *e*, the canal leading from the gullet to the third stomach, *g*, *g*, *g*, *g*; *h*, *h*, the fourth stomach; *i*, a tubercle opposite to the orifice of the *pylorus*; *k*, *l*, the juncture of the third and fourth stomachs.

Fig. 3. exhibits a section of the brain. λμλ, the *callous body*, or central portion of the brain; *MM*, the third ventricle; *mm*, fourth ventricle; φ, canal of communication between the third and fourth ventricles; *E*, pineal gland; 16, mammillary portion of the brain; 47, 48, situation of the organ of amativeness, according to Spurzheim; 57, 58, 59, transparent partition of the brain; 61, anterior commissure of the brain; 62, centre of the fundamental part of the *cerebellum*; 86, 87, 88, 90, fibres in the middle line of the nervous apparatus; II, the organ of philoprogenitiveness, according to Spurzheim; III, organ of inhabitiveness; X, organ of self love; XIII, organ of benevolence; XIV, organ of veneration; XVIII, organ of firmness, or determinateness; XIX, organ of individuality; XX, organ of form; XXIX, organ of language; XXX, organ of comparison.

Fig. 4. represents the anterior part of the right external ear, the cavity of the tympanum, the small bones, cochlea, and semicircular canals: *a*, the malleus; *b*, the incus, with its long leg resting on the stapes; *c*, membrane of the tympanum; *d*, *e*, the Eustachian tube, covered by *f*, *f*, part of the circumflex muscle of the palate; 1, 2, 3, the three semicircular canals; 4, the vestibule; 5, the cochlea; 6, the *portio mollis*, or soft portion of the seventh pair of nerves; A, the malleus; B, the incus; C, the stapes, which is connected to the latter by the intervention of D, the orbicular bone. The bones of the ear are represented in the lower figure, in which they are separated, by the same letters.

Fig. 5. is a representation of the right eye and its appendages, part of the bones of the orbit being cut away. A, the eyeball; B, the lacrymal gland; C, the abductor of the eye; D, attollens; E, levator palpebrae superioris; F, depressor oculi; G, adductor; H, obliquus superior, with its pulley; I, its insertion into the sclerotic coat; K, part of the obliquus inferior; L, the anterior part of the frontal bone cut away; M, the *crista galli* of the ethmoid bone; N, the posterior part of the sphenoid bone; P, the carotid artery; Q, the carotid artery within the cranium; R, the ophthalmic artery; aa, the optic nerve; b, the third pair; c, its joining with a branch of the fifth pair; d, the ciliary nerves, from the lenticular ganglion; the remaining letters of this figure denote the nerves going to the different parts of the face.

Plate 9.—exhibits a general view of the blood vessels: A, the heart, from the left ventricle of which proceeds B, the ascending aorta; C, the arch of the aorta, from which arise D, D, the carotid arteries; E, E, the subclavian arteries; F, F, the subclavian veins coming from the superior extremities and uniting with G, the vena cava superior; H, the jugular vein, which also joins the vena cava superior; I, the temporal artery; K, the humeral artery which divides into L, the ulnar artery, and M, the radial artery; the two latter arteries in their minuter divisions communicate with each other, and are distributed to the palm of the hand and the fingers: N, the descending aorta, which in its course gives off arteries to O, O, the kidnies, and the other viscera, and divides at P into the two iliac arteries; these latter, when they pass out of the cavity of the body and proceed along the thigh, assume the name of the femoral or crural arteries; Q, the bladder; R, the vena cava inferior, formed of the two iliac veins, by which the blood is brought from the lower extremities and conveyed to the right side of the heart, from which it is sent by the pulmonary veins to the lungs; the ramifications of the arteries and veins in the lungs are seen at S, S.

Plate 10.—Fig. 1. exhibits a view of the lymphatics, in an entire subject, which was prepared by the perseverance and industry of Mr Fyfe, demonstrator of anatomy in the University of Edinburgh; and to his liberality we are indebted for permission to copy the figure for the illustration of this part of our work.

A, section of the upper extremity of the sternum, and of the inner extremity of the clavicles, which are turned up; B, B, the internal jugular veins; C, cavity of the right side of the thorax; D, D, the pericardium cut; E, the heart; F, F, the convex surface of the diaphragm; G, G, the integuments and abdominal muscles turned up; H, part of the liver; I, the stomach, and part of the colons hrivelled; K, K, the descending aorta; L, right common iliac artery; M, M, inferior vena cava; N, N, mesentery and small intestines turned to the left side; O, cavity of the pelvis; F, the pubes; S, S, S, inguinal glands distended with quicksilver; T, T, T, branches of the vena saphena major.

The course of the absorbents is so obvious in the figure that letters of reference become unnecessary. They are seen on the upper part of the feet deriving their origin from the toes, and trunks arising from the soles of the feet appear behind the inner ancles. The lymphatics from the outside of the feet and ancles run across the tibia to the inside of the leg; and the principal lymphatics of the leg lie near the great vena saphena, and proceed to the inner side of the knee, and from thence to the inner side of the thigh. In the course of the lymphatics upwards, they form an irregular plexus on the inside of the limbs in gene-

Plates explained.

ral. The inguinal glands at the upper extremity of the thigh receive the lymphatics from the inside of the thigh. These glands are distinctly seen on the right side of the figure, and the vessels appear shooting from them in a radiated form; and on the same side is seen the iliac plexus, formed by the trunks which ascend, partly from the inguinal glands behind Poupart's ligament, and partly from the contents of the pelvis, along with the iliac blood-vessels. The lymphatics which originate on the surface of the *os sacrum* are visible at the bifurcation of the aorta. Some appear at the sides of the inferior cava, and over the aorta. The vessels and glands forming the lumbar plexus are also seen, and a few of many injected lacteals on the mesentery directing their course toward the thoracic duct.

Trunks of absorbents descend from the lower part of the liver, and from the other viscera, and meeting with the lacteals and lumbar plexus, terminate in the thoracic duct. A large lymphatic gland which seems to be formed of convoluted branches appears on the convex surface of the diaphragm, and large lymphatic vessels which perforate the diaphragm from the right side of the liver enter this gland.

On the superior extremities an extensive plexus is formed by the superficial lymphatics which pass from the anterior side of the extremity upward, and receive many branches which ascend in an oblique direction from the opposite side of the arm. The lymphatics of the superior extremities enter the axillary glands, and the principal trunks proceed from these glands, and terminate in the trunk of the left arm along with the thoracic duct. On the right side of the neck are seen some of the lymphatic vessels and glands which form the jugular plexus; and the general termination of the lymphatics of the right side of the head and neck, right arm, &c. is in the angle formed by the right internal jugular and subclavian veins.

Fig. 2. exhibits an outline view of the different layers of the skin of a negro who died of small-pox; *a*, is the cuticle; *b*, a layer of a finer texture; *c*, the *rete mucosum*, which in the negro is black; *d*, the membrane of small-pox and other cutaneous eruptions, according to Mr Cruikshank; *e*, the cutis, or true skin.

Fig. 3. is a representation of the arrangement of the pores of the skin, as they appear in the corners of certain angular parts of the surface.

Fig. 4. is a view of the gall bladder, its ducts and connection with the intestines: *a*, the gall bladder; *b*, the cystic duct; *c*, the hepatic duct; *d*, the *ductus communis choledochus*, or common duct; *e*, *e*, the pancreatic duct; *f*, the entrance of the common duct into the duodenum.

Fig. 5. exhibits a view of the jejunum, a part of the small intestines of a person who died soon after taking food, when the lacteals distributed on the mesentery were distended with chyle; *a*, *b*, *c*, the intestine; *d*, *d*, the minute branches of the blood-vessels; *e*, *e*, the trunks of the blood-vessels; *f*, *f*, the lacteals; *g*, *g*, *g*, the mesenteric glands.

Errata in Anatomy.

P. 285. col. 1. line 1. for *latter* read *former*, and for *former* read *latter*.
294. col. 1. line 22. for *cerebrum* read *cerebellum*.
295. col. 2. line 37. for *many* read *man*.
300. col. 2. last line, for *play* read *prey*.
303. col. 1. line 30, for *bones* read *bone*.
306. col. 2. line 56, insert a comma after *intestines*, and omit it after *fluids*.
316. col. 2. line 57. for *longer* read *larger*.
324. col. 2. line 60. for *fitted* read *filled*.
326. col. 2. line 52. for *these* read *three*.

INDEX.

Index.

Index.

Analcime.

ANALCIME, a variety of the mineral substance called Zeolite has received this name from its deficient electric property. See MINERALOGY.

Anaxagoras

ANAXAGORAS, an eminent philosopher of ancient Greece, who flourished about 500 years before the Christian era. He is represented as a man of rank and wealth in his native country, Ionia; but with an eager thirst after knowledge, he relinquished the whole to his friends, and engaging in the pursuits of philosophy, "devoted himself wholly," as Cicero expresses it, "to the divine pleasures of learning and the investigation of truth." He repaired to Athens; became a disciple of the Ionian school established by Thales, and spent 30 years of his life in that celebrated city, either as a scholar or a teacher of philosophy. Pericles, famous for his military skill and martial prowess, and Euripides, the tragic poet, were numbered among his pupils. But the opinions of Anaxagoras were too refined for the crude notions which prevailed in the period when he lived. He was charged with innovation in the doctrines of religion, and condemned to death. By the influence of Pericles, this sentence was commuted into banishment. The sayings of the philosopher on these transactions are recorded to have been the following: On the first, he observed, "Nature, long ago, pronounced the same sentence against me;" and when a friend expressed regret on account of his exile, he replied, with a consciousness of his own importance, which some may not unreasonably be disposed to charge to self-conceit, "It is not I who have lost the Athenians, but the Athenians who have lost me." He died at Lampsacus, to which place he retired after his expulsion from Athens; and, in commemoration of the sublime knowledge which he taught, an altar was erected, on which the words *Truth* and *Mind* were inscribed.

The traditionary history of the philosophical doctrines of Anaxagoras is vague and contradictory. But if it be true, as Cicero has asserted, that he first taught, that "the arrangement and order of all things were contrived and accomplished by the understanding and power of an infinite mind," no mean opinion can be held of the extent of his intellectual powers, the grandeur of his views, and the accuracy of his reasonings and conclusions.

ANAXIMANDER, a Greek philosopher, who flourished 600 years before Christ, was the disciple and successor of Thales in the Ionic school, and is said to have been the first of the Grecian philosophers who taught in public, and delivered the principles of his doctrines in writing. As a proof of the progress of this philosopher in mathematical and astronomical learning, the discovery of the obliquity of the ecliptic, the invention of the sun-dial, and the construction of an artificial globe, on which were delineated the divisions of land and water, are ascribed to him. He supposed that the stars are composed of air and fire, which are carried round in their spheres by portions of a divine animating power; that the sun, which is 28 times larger than the earth, occupies the highest place in the heavens; the moon holds the next, and the planets and fixed stars the lowest, while the earth is stationed in the common centre or middle of the universe. To *infinity*, concerning the precise meaning of which inquiry would be useless or unsatisfactory, Anaximander attributed the first principles of all things, or the origin of the universe. "All things are produced by *infinity*, and all things terminate in it," was the general expression of his doctrine. The followers of this philosopher were denominated Anaximandrians.

ANAXIMENES, a Greek philosopher, flourished about 556 years before Christ, and was the disciple and successor of Anaximander in the celebrated Ionic school. Anaximenes ascribed the first principle of all things to air, or a subtile æther, which is infinite, immense, in perpetual motion, and animated by a divine principle. From this air or æther, which seems to be analogous to the *moisture* of Thales, and the *infinity* of Anaximander, proceed fire, water, and earth, by the process of rarefaction and condensation. The earth he supposed to be a body with a flat surface, resting on the air, and the sun, moon, and stars to be igneous masses.

ANBERTKEND, a word which, in some of the oriental languages, has the expressive signification of "the cistern which holds the water of life," is applied to a celebrated Brahminical book containing an exposition of the Hindoo religion and philosophy. This work consists of fifty discourses, each of which is divided into ten chapters; and a translation from the original into the Arabic is designated "the marrow of intelligence."

ANCESTORS, derived from a Latin word which signifies "to go before," denote those from whom a person is descended in a direct line. The peculiar marks of respect and honour, often approaching to a kind of worship, bestowed on ancestors, forms a striking feature in the character of different nations, both ancient and modern. The veneration in which the departed spirits of their ancestors were held by the Romans, and the ceremonious duties performed to their images, which were distinguished by the name of *lares*, *lemures*, or, *household gods*, are familiar to the classical reader. Impressed with similar sentiments, the Russians honour the memory of their ancestors by the celebration of anniversary festivals, under the appropriate name of *kinsman's sabbaths*, when they make solemn visits to the tombs of the dead, with offerings of provisions. Some of the African tribes, believing that the spirits of their fathers exercise a guardian care over their concerns, undertake no affairs of importance without a previous sacrifice of rice and wine to conciliate their favour; the groves, which are supposed to be the residence of these invisible protectors, are regarded as peculiarly sacred, and no woman or child is permitted to approach them. The Moors on the northern shores of Africa shew great respect to their deceased friends. Their tombs are kept clean and whitewashed; and to small temples which are erected over the tombs they resort on holidays, to offer up solemn supplications. But the veneration paid to ancestors by the Chinese is still of a more marked character. Private acts of adoration, accompanied with offerings of perfumes and spiceries, are performed at stated times, and solemn festivals, which are held in spring and autumn, are instituted by public authority in honour of their ancestors. But the striking peculiarity in these ceremonious observances among the Chinese, is the ingenious fiction of elevating their deceased relatives to the same rank with their descendants, when the latter are fortunate in attaining a higher station in society than the former enjoyed, and according to this rank the kind of worship to which they are considered as entitled is regulated.

ANCHISES, a Trojan prince, and the father of Æneas, who is celebrated by Virgil as the great progenitor of the Roman people. According to fabulous history, Venus, captivated with the personal charms of Anchises, appeared to him under the assumed character of a nymph, and bore him Æneas, in whose perilous adventures she acted a conspicuous part. At the destruction of Troy the aged Anchises was carried from the scene of desolation on the shoulders of his son, and died in Sicily.

ANCHOR, a strong, heavy, and crooked instrument, which is attached to a vessel by a rope or cable, and is dropped to the bottom of the water in which a vessel floats, for the purpose of retaining it in any station that is required. For the construction of anchors, see SHIP-BUILDING.

ANCHOR, *to cast*, is the act of letting go the anchor when a vessel is brought to the requisite station; *riding at anchor*, is when a vessel is secured or retained in a proper station; *weighing anchor*, is the act of heaving up the anchor from the bottom when a vessel changes its station, an operation which is performed by means of the windlass in small vessels, and by the power of the capstan, wrought by numerous hands, in large ships; and *sweeping an anchor* is performed by dragging a rope, the ends of which are fastened to two boats, and the middle is sunk with a weight, along the bottom where the anchor which has been detached from the cable is supposed to lie, and in this way to discover and secure it.

ANCHORAGE, the duty which is levied on vessels for the privilege of coming to anchoring ground, and is analogous to *shore dues* paid by vessels frequenting a port or haven.

ANCHORET, a hermit, or solitary monk. See Anachoret.

ANCHOVY, a species of clupea, which is very abundant in many parts of the Mediterranean, and is the source of an active and lucrative fishery. See Ichthyology.

ANCHUSA, Alkanet, or Bugloss, a genus of plants belonging to the Pentandria class. The root of the *anchusa tinctoria* communicates a fine red colour to oily matters, and is, on account of this property, employed in pharmacy as an ingredient in plasters and ointments. This species is a native of the Levant.

ANCIENT DEMESNE, a tenure by which all manors belonging to the crown, in the time of William the Conqueror and St Edward, were held. Their numbers and names were entered in *Doomesday-Book*. The tenants in *ancient demesne* are of two kinds, one of which holds their lands by charter, and the other by copy of court-roll, at the will of the lord, according to the custom of the manor. Tenants holding originally by this tenure were bound to perform certain services for the maintenance of the king's household; and they were entitled to peculiar privileges.

ANCISTRUM, a genus of plants belonging to the Diandria class.

ANCLAM, an ancient sea-port town in the duchy of Pomerania, and in the circle of Upper Saxony, in Germany, is secured on one side by lofty walls and deep moats, and on the other by a considerable extent of marshy ground, interspersed with rich meadows, which have been long celebrated for excellent pastures; is the capital of a small territory; has manufactures of soap and silk stuffs, possesses some trade; and corn, wood, and glass-ware are enumerated among the exports. N. Lat. 53. 50. E. Long. 13. 42.

ANCONA, a province of Italy, with the title of Marquisate, which is bounded by the gulf of Venice on the east, and is about 65 miles in length, and nearly 50 miles in breadth. The soil, which is fertile and well cultivated, produces abundance of corn, wine, hemp, and wax. The province is watered by numerous streams; the population exceeds 330,000; and Ancona, Ascoli, and Loretto, are some of its chief towns.

ANCONA, a flourishing sea-port town of Italy, and capital of the marquisate of the same name. Traditionary history ascribes its origin to a colony of Syracusans, whom the tyranny of Dionysius drove from their native country, 400 years before the Christian era. Ancona afterwards fell under the dominion of the Romans; was highly favoured by the emperor Trajan; and, by the improvements and benefits which it received from that prince, rose to great commercial prosperity. A splendid triumphal arch of beautiful marble was erected by the grateful inhabitants to commemorate his name. Soon after the commencement of the 18th century, Ancona, by the liberal policy of the popes, was declared a free port, with additional privileges; but, in 1797, it was seized by the French; and in 1799 it was recovered by the allied forces of Austria, Russia, and Turkey, after a severe siege and blockade.

Ancona presents a beautiful appearance when seen from the sea; some of its public edifices, particularly the exchange, were distinguished by their magnificence, but have been defaced or entirely demolished by the rude and unsparing hands of the French revolutionists; the population amounts to 20,000, and the chief exports are corn, wool, and silk. Ancona is 107 miles N.N.E. from Rome, and in N. Lat. 43° 58′, and E. Long. 13° 29′.

ANCUS MARTIUS, the fourth king of the Romans, and the grandson of Numa Pompilius, contributed greatly to the power and prosperity of his country, by the extension of its territory, and the enlargement of the city, and died about 615 years before the Christian era.

ANCYLE or ANCILE, a shield which it was pretended fell from heaven in the time of Numa Pompilius, and accompanied with a supernatural declaration that Rome should continue the sovereign of the world, as long as she retained this sacred gift. To obviate the risk of its loss, eleven shields were made exactly of the same form and appearance, and were formally deposited in the temple of Vesta, under the superintendance of twelve priests who were appointed to that service; and at the festival of the *ancylia*, or the 1st of March, the twelve shields were carried round the city in solemn procession.

ANDALUSIA, a province of Spain, which is bounded on the north by Estremadura and New Castile, by the Straits of Gibraltar and the Atlantic ocean on the south, and by the Portuguese territory on the west, is more than 300 miles in length and about 150 miles in breadth, and is distinguished by the fertility of its soil. This province is watered by the Guadalquiver. Its productions are corn, wine, oil, fruits of the richest kinds, sugar, barilla, and silk. The horses of Andalusia are celebrated as the best in Spain; and the sheep afford wool of an excellent quality. Mines of quicksilver, lead, and some other metals, have been discovered in the mountains. The air of this province is temperate and salubrious. The estimate of the population exceeds 1,200,000; Seville is the capital; and Cadiz, Cordova, and Xeres de la Frontera, are ranked among the chief towns.

ANDALUSIA, NEW, a district or division of Terra Firma, in South America, which is included under Spanish Guiana.

ANDAMAN ISLES, a cluster of islands in the bay of Bengal, and opposite to the coast of Malacca, two of which are distinguished by the name of Great and Little Andaman. The Great Andaman is about 140 miles in length, and about 20 in breadth, the coasts are deeply indented with creeks and arms of the sea, some of which form excellent harbours; much of the surface is covered with thick forests, among which ebony and the Nicobar bread-fruit trees are abundant, and the most common quadrupeds are rats, monkies, and wild hogs. The extent of the Little Andaman is stated at 25 miles in length and 15 in breadth. During the wet season these islands are exposed to incessant torrents of rain.

The inhabitants of the Andaman islands, the number of which is estimated at 2000, or 2500, are still in a condition of extreme barbarity; they depend chiefly on fishing for their precarious subsistence, and their huts, and implements, and utensils of every description, are of the rudest construction. They are altogether without clothing, and cover their bodies with a plaster of mud, which, being dried in the sun, defends them from the troublesome attacks of insects. They are generally of a diminutive stature, and their flat noses, thick lips, and woolly hair, indicate, as some suppose, their descent from an African race. Of late years a British settlement, to which convicts are transported from Bengal, has been established in the Great Andaman.

ANDELY, Great and Little, two towns in the department of Eure in France, the former situated on the banks of the Gambion, and the latter on the Seine. The population is about 4000. The woollen manufactures, which were established in the beginning of the fifteenth century, now afford active employment to 1000 persons; a copper foundery occupies the industry of another portion of the inhabitants, and Andely deserves notice as the birth-place of the celebrated painter Poussin.

ANDERAB, a rich and populous city of independent Tartary, situated on a river of the same name, and at the foot of the mountains which divide India and Persia from Great Buckharia. The only route to India is through this place. An oppressive duty of four per cent. on all goods in their passage, is a source of considerable revenue to the khan, or ruler of the province. *Lapis lazuli* is a production of the neighbouring mountains, and the scanty localities of this beautiful and sparingly distributed mineral have been magnified into the name of quarries.

ANDERNACH, the *Antoniacum* of the Romans, some of whose defensive works are still visible, is a town of Germany, formerly belonging to the electorate of Cologne, and, during the revolutionary extension of the French territory, included under the department of the Rhine and Moselle, is situated on the banks of the Rhine; has a considerable trade in pottery, timber, and millstones, and derives an ample revenue from the duties levied on vessels which navigate the river, and particularly from the immense rafts of timber which are conveyed down the Rhine to Holland.

ANDERO, Saint, or Santander, a sea-port town of Spain, on the Bay of Biscay. The population is estimated at 5000, a considerable proportion of whom are engaged in successful commerce; the harbour admits vessels of moderate burden, but the access to it is not very commodious; and the establishment of a royal dock-yard for building ships for the Spanish navy is now abandoned. N. Lat. 43°. 27′. W. Long. 4°.

ANDERSON, Alexander, an eminent mathematician, and an assiduous student of ancient geometry, who flourished about the beginning of the seventeenth century, was a native of Aberdeen, in Scotland, and in early life removed to Paris, where he became a teacher of mathematics. Mr Anderson was the author, or editor, of various works on the subjects of his favourite pursuits, chiefly relating to the more profound disquisitions of the ancient geometers; and in the latter character he published the works of Vieta, a celebrated French mathematician, to which he not only furnished an able preface, dedication, and appendix, but, by his learned commentaries, supplied what was defective, and illustrated what was obscure. The works now alluded to appeared between the years 1612 and 1619. But the scanty biography of this distinguished mathematician is equally silent in reference to the time of his death, and to the exact period of his birth.

A remarkable coincidence of kindred genius existed in the family of Anderson. His brother David, the proprietor of Finzaugh, a small estate in Aberdeenshire, was no mean proficient in mathematical and mechanical knowledge; and the daughter of David Anderson, who married the Reverend John Gregory of Drumoak, in the same county, was the mother of James Gregory, the inventor of the reflecting telescope. To the tuition of this lady, with what truth we know not, is ascribed that strong bias to abstract investigations, which seemed to become hereditary in her family, and continued long to associate the name of Gregory with the sublime departments of mathematical science.

ANDERSON, John, a learned philologist and naturalist, was descended from a Swedish family, who had settled in Hamburgh, and was born in that city in the year 1674. His early life was assiduously devoted to the acquisition of languages; and his knowledge of the Greek tongue was so profound and familiar, that when he travelled in Holland in the train of Peter the Great of Russia, the learned men of that country regarded him as a native of Greece. He was originally destined for the church, but his own inclination led him to the study of law, which he practised for some time as a profession after his return to his native city. For several years he executed the office of a public functionary of Hamburgh, was engaged in various political negociations, and in 1732 was raised to the dignity of chief magistrate. But the laborious duties of an active citizen did not altogether preclude him from the cultivation of science, and an occasional correspondence with Leibnitz, and other learned men. His death happened in 1743, and he left behind him various manuscripts on subjects of philology and political economy; but he is best known as the author of *A Natural History of Iceland and Greenland*, which appeared originally in the German language, and was afterwards translated into French. He contributed liberally to the enlargement and improvement of a public museum of natural history, which was established by his father at Hamburgh.

ANDERSON, Adam, author of a work on commerce, was a native of Scotland, which, it would appear, he had left in early life, for he was long employed as a clerk in the South-Sea House, was afterwards promoted to the office of chief clerk of the Stock and New Annuities, and was appointed a trustee for establishing the colony of Georgia in America. In fulfilling the duties of the different situations which he held, his attention was probably directed to the consideration of those topics which form the subject of his *Historical and Chronological Deduction of Trade and Commerce*, which was published in 1762, a very elaborate work, and the only literary production by which he is known. He died in 1775.

ANDERSON, Dr James, a distinguished writer on rural affairs and some branches of political economy, was born at Hermanston, a village near Edinburgh, in the year 1739, and was destined when very young, in consequence of the death of his parents, to the occupation and management of a small farm which had continued for several generations in the possession of the family. Guided by his own sagacity, or directed by the advice of friends, he saw the importance of general knowledge in conducting the complicated business of husbandry, and, among other acquirements, he bestowed a large share of his attention on chemistry, which he studied assiduously under the celebrated Cullen. At the age of fifteen he entered on active life, remained a few years on the possession long held by his ancestors, and removed to a large farm in Aberdeenshire, on which he resided for twenty years. In 1771 his *Essays on Planting* appeared periodically in the Edinburgh Weekly Magazine, under the signature of *Agricola*, and were published, in 1777, in a collected form. In 1780, he received from the University of Aberdeen, the honorary title of Doctor of Laws, and three years afterwards he returned to the vicinity of Edinburgh. A pamphlet, on the subject of the North British Fisheries, which he circulated among his friends, attracted the notice of Government, and, under the authority of the Lords of the Treasury, he surveyed, in 1784, the western coast of Scotland, with a view to the improvement of the fisheries and other departments of internal economy; and in the succeeding year, the substance of his Report of the Survey was published.

After the lapse of a few years, the literary labours of Dr Anderson took a wider range, when he commenced the *Bee*, a periodical work, which appeared in 1791, in weekly numbers, and swelled out to eighteen volumes 8vo, an unusual magnitude for such undertakings. But when it is known that a large proportion of its multifarious disquisitions were contributed by himself, further proof is not needed of the various acquirements and laborious industry of the author.

Dr Anderson fixed his residence in the neighbourhood of London, in 1797; and in 1799, he undertook another periodical work, under the title of *Recreations in Agriculture, Natural History, &c.* which he continued, by furnishing a considerable share from the stores of his own mind, till six volumes 8vo were completed. This was his last literary production, with the exception of Selections from his Correspondence with General Washington, and a pamphlet on the Causes and Means of obviating the Scarcity of Grain in Britain. After this publication ceased in 1802, the only subjects which seem to have occupied the attention of Dr Anderson, in his retreat at Isleworth, were the construction of a hot-house without artificial heat, experiments to determine the heat and moisture most suitable for different plants, and the means of destroying wasps to prevent their depredations on fruits. The method suggested by Dr Anderson, for the extermination of these destructive insects, was to discover and destroy the queens before they deposited their eggs in the early summer months; and for this purpose an association was formed and rewards offered for every queen wasp presented within a limited period. But the plan was either defective in its principle, or it was not pursued with sufficient zeal and perseverance; for it is not understood that the ravages of the wasp in that neighbourhood have at all diminished.

For some years previously to the close of life, Dr Anderson began to feel the infirmities of declining health. He died in October 1808, in the 69th year of his age. Of thirteen children, by his first wife, five sons and a daughter only survived him; and one of his sons, who became eminent as an engraver on wood, has since terminated his mortal career. His second wife was a widow lady in Isleworth.

Beside the works already noticed, Dr Anderson was the author of numerous productions, chiefly relating to rural economy, as well as of various memoirs on kindred topics, which appeared in periodical publications. All his writings bear the stamp of a vigorous understanding and a well-informed mind. The charge of prolixity which has sometimes been made is not altogether groundless; and some of his speculations may be pronounced fanciful, as in his treatise on peat-moss, which he attempts to prove derives its origin from the growth and increase of a living vegetable, and not from the decay of dead plants, according to the generally received and obvious opinion. Dr Anderson's claim to the discovery of the new mode of draining, for which a parliamentary reward was granted to Mr Elkington, has been stated in the chapter on Draining, under Agriculture.

ANDES, a chain of mountains in South America, which, by their vast extent and immense height, exceed every other elevated ridge in the Old World. This mountainous range stretches more than 4000 miles from the straits of Magellan, in the 53d degree of south latitude to the isthmus of Darien, which lies in the 8th degree of north latitude, and preserving a mean distance about 140 or 150 miles, runs nearly parallel to the western shores of the American continent. The chief information relative to the Andes is derived from the Academicians who visited these lofty regions in 1736, and more recently from the enterprising exertions of the adventurous and indefatigable Prussian Traveller, Humboldt, whose scientific descriptions have in some degree rendered Europeans familiar with the surprising features of this portion of the New World.

Andes.

Divisions of the Andes.—The great mountainous chain of the Andes presents a natural division into a principal and three subordinate ridges. The principal ridge runs from south to north, the whole length of South America, and the three subordinate branches pass off from the main trunk, nearly at right angles, penetrate far inland, in an easterly direction, and divide that wide continent into three immense vallies.

The grand primary ridge of the Andes divides to the southward of Cuenza, and continues double to the northward of Popayan, a distance of 500 miles; and in this double ridge is included the elevated plain of Quito. The western ridge in this part of its course is about 120 miles from the shores of the Pacific ocean. This long valley rarely exceeds the breadth of 20 miles, and in some places it is much narrower; but a fertile, well cultivated, and populous plain, raised to the astonishing elevation of between 8000 and 9000 feet above the level of the sea, presents a striking feature in the wonderful scenery of the American continent. As the principal mountains of the double ridge approach or recede from each other, they form small vallies, some of which are distinguished as the station of different towns or cities, as Cuenza, Riobamba, Latacunga, and Quito.

Principal mountains.—The lofty summits of the principal mountains of this portion of the Andes, which are invested with perpetual snow, exhibit another grand feature in the New World. Pinchinca, contiguous to the city of Quito, on the north, and, in a southward direction, Corazon, Ilinissa, Carguayraso, and, the loftiest of the whole, Chimborazo, are the chief mountains of the western ridge; and Cayamburo, Antisana, Cotopaxi, Tunguragua, Altair, and Sangai, form the highest summits of the mountainous boundary on the east and south.

Pinchinca.—This mountain has acquired scientific celebrity from being the station selected by one party of the academicians, who were engaged in 1736 in measuring a degree of the meridian. It is a volcanic mountain, and its crater, when visited by Condamine at the time alluded to, was extinct, and covered with snow; but in 1802, when it was examined by Humboldt, symptoms of activity appeared. On a rock projecting from the side of the crater, that adventurous traveller took his station to survey the dreadful gulf below. The mouth of the volcano presents a circular opening not less than a league in circumference. The interior of this huge excavation is dark and gloomy; but within its black walls the peaks of several mountains of inferior magnitude are distinctly seen. The observations of Humboldt fix the height of Pinchinca, above the level of the sea, to be about 15,000 feet.

The academicians, during their stay in this elevated station, experienced all the horrors of winter, with the rapid and singular contrast of an occasional glimpse of sunshine. The field-tents, which had hitherto served for their accommodation, were here altogether insufficient to protect them from the severity of the cold, or to resist the fury of the tempest. The whole party crowded into a single small hut, and, to supply them with light and heat, lamps were kept burning day and night. The wind blew with dreadful violence, and the accumulated fogs became so dense as to veil them at noon in the darkness of midnight. Sometimes the scene changed; the thick mists were seen collecting in regions far below them; the lightnings flashed through the dark clouds; and the distant roar of the thunder re-echoed from the surrounding mountains; while the air resumed its serenity, and the sun's rays darted a cheering influence on their dreary abode. But this was only a temporary cessation of the storm. The fogs again returned and gathered around denser and darker; the wind blew with redoubled rage; and the showers of hail and snow were almost incessant. In the midst of this tempestuous war of elements, the danger of being overwhelmed under a thick mass of snow, or of being swept down the precipice by the fury of the blast, alternately presented itself. The severity of the cold produced violent effects on the bodies of the travellers; their feet became inflamed and swelled, so that they could not walk without great pain; and the lips also inflamed, swelled, and bled, with the slightest motion.

Chimborazo.—Chimborazo rears its snowy head to the greatest height of all the mountains of the elevated ridge of the Andes. No traveller has yet reached its summit. The enterprising Humboldt, by pursuing his ascent along a ridge of volcanic rocks which were free from snow, was not more than 1400 feet from its loftiest pinnacle. Arriving at the altitude of 18,000 feet, his respiration was uneasy and laborious, from the thinness of the air; but, determined to accomplish his arduous and unparalleled undertaking, he was not deterred from proceeding, till a deep and impassable fissure, which crossed his path, precluded his farther progress, and forced him to abandon it in despair. In this dreary region of perpetual winter, no living sound was heard; all was melancholy, dismal, and silent; the scanty productions of vegetable life were limited to diminutive mosses; and the few rays of light, which occasionally penetrated the thick fogs, unveiled the horrors of the yawning abysses around. Scorified rocks and masses of pumice-stone, which were observed on different parts of the mountain, are considered as indications of volcanic agency; but no records are preserved of Chimborazo having been in a state of activity. The height of this mountain, estimated by the trigonometrical measurement of Humboldt, is stated at 3267 toises, or a little more than 20,000 feet.

Antisana.—In attempting to reach the summit of Antisana, Humboldt arrived at a higher point than the academicians. Having ascended more than 16,000 feet above the level of the sea, the air was so much rarified that the blood burst out from different parts of his face; all his attendants were seized with extreme debility, and one of them actually fell into a fainting fit. The barometer had sunk to 14 inches and 7 lines. Antisana, which is one of the mountains of the eastern ridge, is volcanic.

Cotopaxi.—Cotopaxi, the seat of another volcano, belongs to the eastern range; and its altitude, according to Condamine, falls little short of 18,000 feet. The first eruption of this volcano, of which any record is preserved, coincided nearly with the time of the Spanish invasion, and, it is said, facilitated the conquest

Andes. of that devoted country, in consequence of a prediction, current among the natives, that the period was now arrived when their land should be occupied by strangers; and regarding that natural event as a warning signal of the dreaded calamity, yielded up their territory an easy prey to their rapacious invaders. After the lapse of more than 200 years, indications of an approaching eruption were observed; and in 1743, when the flames burst out from various openings near the summit, they were immediately succeeded by a prodigious torrent of water, which swept off detached cottages, towns, and villages, in its irresistible course, and carried devastation and ruin far and wide. After a few days the torrent of water ceased to flow; but the flames, which continued longer, were accompanied with a tremendous noise, which was supposed to proceed from the violent rushing of the wind through the new openings of the mountain. Might it not, with more probability, be ascribed to the sudden conversion of a large quantity of water into vapour?

Sangai is another volcanic mountain, included in the double range, and is remarkable for the frightful sounds which are distinctly heard at the distance of 30 or 40 leagues, when it is in a state of activity. Altair and some others are also the seat of volcanoes; and Tunguragua, long celebrated for its hot springs, is the frequent resort of invalids from the surrounding country to enjoy the benefit of warm-bathing. The character of the American volcanoes is very different from those of Europe in the nature of the ejected matters. Immense torrents of mud and water take place of the ashes and lava which are discharged by the latter; and, what is not the least singular fact connected with the history of the volcanic eruptions of the New World, a particular kind of fish, to which Humboldt has given the name of *pimelodus cyclopum*, are sometimes thrown out in great numbers along with the mud and water. The origin of these fish, which has been the subject of speculation, is probably to be sought for in some of the lakes or rivers in the vicinity which have a communication with the excavated regions of the mountains by means of the numerous fissures by which they are traversed, or by temporary openings produced by earthquakes, which often accompany volcanoes.

Subordinate ridges.—Three subordinate branches, or *cordilleras*, according to the Spanish appellation, pass off from the grand primary chain of the Andes. The *first* branch, in tracing the great ridge from south to north, is the cordillera of *Chiquitos*, which traverses a province of the same name. Proceeding in its course eastward, this subordinate ridge forms a sweep between the 15th and 20th degree of south latitude, and connects, by a mountainous chain, that portion of the Andes which is contiguous to Chili and Peru on the west, with the elevated regions of Brazil and Paraguay on the east. The tributary streams of the La Plata flow down the southern side of this ridge; numerous rivers, which swell the waters of the Maragnon, have their sources on its northern declivity; and the *Pampas*, a dead flat, of immense extent, formed to a great depth of alluvial soil, and clothed with a luxuriant growth of tall coarse grass, which feeds innumerable multitudes of wild cattle, stretches to the southward of the cordillera of Chiquitos. Andes.

The middle branch, which is sent off from the principal ridge of the Andes, has been denominated by Humboldt the *cordillera of the cataracts of the Oronoco*. Of this elevated tract 600 miles were surveyed by that enterprising traveller; but the greater part of the chain consists of inaccessible regions, which are very little known. When it leaves the main ridge, the course is nearly eastward; about the fifth degree of north latitude it crosses the Oronoco, and takes a north-east direction towards the source of the river Caronis. Between the fourth and fifth degree the breadth is greatly diminished; and stretching to the south and south-east, joins the granitic mountains of Guiana. The scanty information which has been obtained concerning these extensive wilds, is derived from the singular adventures of a Spaniard, who, being familiar with the language of the different native tribes, assumed the Indian garb, travelled unsuspected among the ferocious inhabitants, and having reached the lake of Parimé and the Amazons river, returned in safety. The fabled account of *El Dorado*, or the golden mountain, which had long gratified the credulity of ignorance, was corrected and explained by his observations, from which it appears, that this far-famed mountain, which stands on the banks of the Mao, a tributary stream of the Oronoco, is composed chiefly of a shining micaceous schistus. The mean altitude of this chain is about 4000 feet above the level of the sea; but Duida, a volcanic mountain, and the highest of the whole ridge, rears its lofty head to more than 8000 feet. This cordillera is most abrupt and precipitous on the south; and through the valley, of which this chain forms the northern boundary, and which is covered with impenetrable forests, the Maragnon rolls its mighty stream.

The most northerly of the secondary branches, is the highest and the narrowest. It passes off from the Andes near Popayan, proceeds in a northerly course towards the Caribbæan sea, approaching the lake Maracaybo, turns suddenly to the east, and advances along the coast to Trinidad. Some of the mountains of this subordinate ridge are remarkable for their elevation. The *Sierra Nevada*, or, as its name imports, snowy summit of St Martha, in 10° of north latitude, rises to the height of nearly 14,000 feet above the level of the sea; and the altitude of the *Sierra Nevada* of Merida, in north latitude $8\frac{1}{2}$°, exceeds 15,000; and although they are covered with perpetual snow, springs of boiling sulphureous water continually flow from their sides. From that part of the chain which stretches between Merida and its termination near Trinidad, two parallel ridges branch off, and form the boundaries of three vallies of unequal elevation, which are arranged from east to west, and seem to have been the beds of ancient lakes. The valley of the Caraccas, measured by Humboldt, barometrically, is more than 2500 feet above the level of the sea; the valley of Aragua is lower, and is estimated at 1300 feet; while the valley or plain of Monai rises only about 500 or 600 feet above the surface of the ocean. Another lofty part of this chain is what is denominated the *Silla* or Saddle of the Caraccas, whose height determined by Humboldt, by barometrical observations, exceeds 8000 feet; but the mean altitude of the whole cordillera is between 4000 and 5000 feet.

Mineral productions.—The mineral riches of this remarkable portion of the globe roused the avarice of the Spaniards, and urged them, through blood and carnage, to the subjugation, and in many places the utter extermination of the native inhabitants. With the exception of lead, the Andes are the repositories of almost every other metal; but of the precious metals silver has been always the most abundant, and still affords a large annual supply to the Spanish treasury.

The rocks which compose the stupendous ridges of the Andes, belong partly to the primary, and partly to the secondary class; granite, quartz, micaceous, and argillaceous schistus, are the prevailing rocks, in a large proportion both of the principal and subordinate chains. In some places the primitive rocks are covered with sand-stone, lime-stone, and small patches of gypsum. But the geological constitution of the central Andes exhibits peculiarities in the immense thickness of the strata, which find no counterpart in any other part of the world. The loftiest summits of the principal ridge are entirely composed of porphyry, which is distributed in enormous masses of more than 10,000 feet thick; the thickness of a stratum of sand-stone is stated at 5000 feet, and that of a huge mass of pure quartz exceeds 9000 feet; and the basalt of Pinchinca is deposited at an elevation exceeding 15,000 feet, which is 10,000 feet higher than any locality of that kind of rock yet discovered in the Old World.

Fissures.—The Andes are not more distinguished from the mountains of other parts of the globe by their great extent and elevation, than by the remarkable fissures with which they are traversed. Perpendicular rents or fissures are not uncommon in basaltic regions. Hooker, who visited Iceland in 1809, mentions various chasms which he met with in that rugged country, one of which he describes as 200 feet high, and about 20 yards broad. Through this chasm the traveller passes in his progress to one quarter of the island. But the rocky chasms of Iceland, with all their horrors, dwindle into tameness and insignificance, when compared with the tremendous rents of the Andes, some of which are nearly a mile in depth. Some of these fissures have natural bridges, which afford an easy communication to the traveller. A bridge of this description, which connects the two sides of a rent called Icononzo, and through which a river flows from the mountains, is 50 feet long, 40 feet broad, and at its middle part about eight feet in thickness. The height of this arch above the surface of the stream is not less than 300 feet, and about 60 feet a smaller arch, consisting of three masses of stone, is projected over the same fissure. The Peruvians sometimes form a communication with the opposite sides of these rents, by means of hanging bridges, constructed of ropes, manufactured from the strong fibres of the American aloe, and covered with reeds; and to render them more secure, a border of a kind of basket work is sometimes added.

Climate.—Every variety of climate prevails in the Andes. Perpetual spring reigns in the lower regions, and the glowing influence of a vertical sun produces the gayest and most luxuriant vegetation; the dreary abode of winter is for ever fixed in the loftier summits, from which all vegetable and animal life is excluded; while the intermediate regions present all the diversified shades of the milder and more temperate portions of the earth.

The line of perpetual snow, or that point where it freezes during some part of every day throughout the whole year, is at the height of about 15,000 feet above the level of the sea, under the equator; and it has this peculiarity, that the uniformity of temperature which prevails in these regions, preserves this line always at the same height.—The reader's trouble will be amply rewarded, by the acquisition of much curious information concerning these stupendous mountains, in the perusal of Ulloa's Travels in South America, and of the later work of Humboldt on the same subject.

ANDOVER, a borough town of Hampshire, in England, with a population exceeding 3000, has some trade in malt, and a manufacture of shalloon; is noted for its excellent inns, and the traces of Roman encampments which are still visible in the vicinity. Andover is on the great road between Exeter and Plymouth, and is about 65 miles west from London, and 18 miles E. N. E. from Salisbury.

ANDRACHNE, or Base Orpine, is a genus of plants belonging to the Monoecia class.

ANDRENOVIAN ISLANDS, a group of islands forming part of the chain which is included under the general denomination of Aleutian islands, and which stretches between the western shores of America and the eastern continent of Asia in the Northern ocean. See Aleutian Islands.

ANDREW, the Apostle, the son of Jonas, and the brother of Simon Peter, was a native of Bethsaida in Galilee, followed the occupation of a fisherman, and had been a disciple of John the Baptist. Convinced of the divine mission of Christ, in consequence of the miraculous draught of fishes, they forsook their employment to preach and propagate his doctrine. After the ascension of Jesus Christ, the apostles determined by lot to what countries their labours should be severally directed. The apostle Andrew was appointed to Scythia and the adjoining regions; and proceeding on his destined mission, he journeyed through various parts of Greece, and had reached Patræ, a city of Achaia, then a Roman province, where he was apprehended by the command of the governor, severely scourged, and condemned to the death of the cross, the form of which is said to have been that of the letter X, and hence called St Andrew's cross. Bound with cords instead of being fastened with nails, he lingered two days in this painful situation before he expired. He suffered martyrdom on the 30th November, the day on which his festival is celebrated in those churches in which such observances are attended to; but the year is undetermined. His body was afterwards removed by the Emperor

Andrews.

Constantine to the great church at Constantinople, which he erected in honour of the apostles.

ANDREWS, James Pettit, a historian and miscellaneous author, was a native of Berkshire in England, and was born in the year 1737, spent part of his early life in the militia regiment of his own county, and was afterwards appointed a commissioner of police in London, the duties of which he faithfully discharged till his death. The first of his literary productions was a biographical sketch of his friend and relation, Mr Penrose, to an edition of whose poems, published in 1781, it was prefixed as a prefatory discourse. A pamphlet in behalf of Chimney-sweepers Apprentices, exposing the cruelty and barbarity of their treatment, which appeared in 1788, was followed in the succeeding year by *Anecdotes Ancient and Modern*, and by his *History of Great Britain, connected with the Chronology of Europe*, 2 vols. 4to. in 1794 and 1795; which latter is the most elaborate work of the author, and is conducted on a peculiar plan, which is well calculated to exhibit a chronological view of European history. While the history of England is detailed on one page, the opposite page presents a brief notice of the more important cotemporary events of the principal nations of Europe; and longer narratives of the state of government, manners, literature, and science, are occasionally interposed in the form of appendix. The work commences with the period of the Roman invasion of Britain, and terminates with the accession of Edward VI. Mr Andrews published, in 1796, a continuation of *Henry's History of Britain*, in one 4to volume. Beside the works now enumerated, which afford ample proof of industry and research, he was the author of various literary productions of a more fugitive nature. Mr Andrews died in August 1797, in the 60th year of his age.

ANDREWS, St., an ancient borough and seaport town of Fifeshire, in Scotland, and the seat of the oldest of the four Scottish universities, stands on a rocky promontory at the bottom of a bay of the same name, and on the south side of the frith of Tay.

Origin and Antiquities.—According to the traditionary legend, Regulus, a Greek monk, warned by a vision from heaven to preach the gospel to the Picts of Britain, left his native country towards the end of the 4th century, and having encountered a tempestuous voyage, was shipwrecked in the bay of St Andrews. But the Pictish king received the saint hospitably, embraced Christianity along with many of his subjects, gave him one of his royal palaces for a residence, and built a church bearing the name of St Regulus or St Rule, from that of the saint; and to which it is said, but surely with little probability, that part of the walls, and the tower, which is 20 feet square and 103 feet in height, yet remaining, and still a solid structure, belonged. The name of St Andrews is derived from the relics of the apostle Andrew, which Regulus brought with him into the country; and when the Picts were subdued by the Scots, the seat of government was transferred, in 840, from Abernethy, the capital of the Pictish kingdom, to St Andrews.

Andrews.

The priory, to which great privileges and rich revenues were annexed, was founded in 1120. But, excepting the surrounding wall, scarcely any other vestiges remain. The piety of succeeding ages extended the religious establishments of St Andrews by the erection of two convents, of which the only remains are part of a chapel, which is deservedly admired as a fine specimen of Gothic architecture. The cathedral church, begun in 1159, was not finally completed till 157 years had elapsed, and was demolished by the misguided fury of the populace, inflamed by a sermon of the great reformer John Knox against idolatry, exactly at the end of four centuries from the commencement of the edifice. The mouldering remains of the east and west ends and part of the south wall, present to the contemplative mind a melancholy contrast with its former magnificence. St Andrews was erected into an archbishoprick after the middle of the 15th century, and continued the seat of the primate of Scotland during the episcopal establishment.

The castle, of which little now remains, was built in the 12th century, on a rock projecting into the sea, and was long conspicuous in Scottish history. It was the usual residence of the prelates of St Andrews, the birth place of James III. of Scotland, and the bloody scene of the murder of Cardinal Beaton, by a party of the covenanters, which was regarded as an act of retributive justice for his cruelty in condemning to the stake George Wishart, a protestant reformer, and witnessing from a window, which is still pointed out, the execution of the horrid sentence.

University.—The university of St Andrews, founded by Bishop Wardlaw in 1411, included formerly three colleges: 1. St Salvator's, founded by Bishop Kennedy in 1458; 2. St Leonard's, founded by Prior Hepburn in 1522; and, 3. St Mary's, or the New College, from its later erection, begun by James and David Beaton, and finally established by Archbishop Hamilton, in 1553. St Salvator's and St Leonard's colleges were conjoined in 1747 under the name of the *United College*; and the buildings of the latter were sold and converted to private use. Divinity, Church history, and Oriental languages only are taught in St Mary's college; but in the United College, beside the ancient languages, the usual academical courses of philosophy are delivered. The number of students in both colleges rarely exceeds a hundred. The church of St Salvator is adorned with a fine Gothic tomb consecrated to the memory of the founder. In this tomb, as tradition reports, six maces of magnificent workmanship, supposed to have been secreted for preservation in times of civil dissension, were found concealed about the end of the 17th century, one of which was presented to each of the other three Scottish universities, and the remaining three were retained.

Modern state.—The situation of St Andrews, on a steep, projecting promontory, with a fertile country to the westward, and extensive downs, or *links*, on the north and south, is striking and picturesque; and buildings, venerable from antiquity, or ruined towers, rearing their crumbling heads among edifices of modern form and construction, exhibit altogether a singular feature in its character. The three principal streets, which run from east to west, are intersected by smaller lanes. The buildings of the Philosophy, or United college, are in North Street; and those appropriated to St Mary's, or the Divinity college, are in South Street. This town was erected by David I. in 1140, into a royal borough; and the charter of Malcolm II. written on a small slip of parchment, is still preserved.

With a population not much exceeding 3000, manufactures must be limited. The making of golf-balls employs a few hands; and in 1793 the manufacture of sailcloth, of a particular fabric for strength and durability, was introduced by Mr Dempster, the inventor, who obtained a patent for his improvement. At one period the trade of St Andrews was considerable; but it has now declined, and the few vessels belonging to the port are employed in the coasting trade. In comparing the present state with the more splendid and flourishing periods of its history, it has been stated that 70 bakers were required to supply it with bread, while nine or ten in the present day are quite adequate to the demand. Archery once flourished, but has now gone into disuse; and golf and foot-ball are now said to be the chief amusements of the inhabitants. It is curious to observe, that the two latter games were formally prohibited by an act of the legislature in the time of James II., as hurtful and unprofitable. St Andrews is in N. Lat. 56° 19′, and in W. Long. 2° 50′, and 38 miles N. E. from Edinburgh.

ANDREWS, St. or Andre's, St. an island in the Caribbæan sea, opposite to the province of Nicaragua in Mexico, and remarkable for the magnitude of the cedar trees, and not less so for the absence of birds and beasts from the land, and fish from the rivers; an assertion which has probably proceeded from careless or inaccurate observation, and requires farther investigation to be fully verified.

ANDROIDES, a machine in the human form, which, by means of mechanical contrivances, performs the motions or actions of man; such were the flute-player of M. Vaucanson, and the chess-player of M. De Kempelen, which were exhibited some years ago in different parts of Europe, and more lately the figure of a young lady which plays the forte-piano, the magician, and some others, constructed by M. Maillardet, a most ingenious Swiss artisan. See Automaton.

ANDROMEDA, according to fabulous history, was the daughter of Cepheus, a king of Ethiopia; and Cassiopeia, the mother, vain of her beauty, thought herself entitled to be preferred to Juno or the Nereids; Neptune, as a punishment, inundated the kingdom, and let loose a sea-monster to ravage the country. The response of the oracle declared, that the calamity could only be averted by exposing Andromeda to be devoured by the monster. She was chained to a rock, delivered by Perseus, afterwards became his wife, and was translated to the heavens by Minerva.

ANDROMEDA, a constellation of the northern hemisphere, near Cassiopeia and Perseus, the body of which is distinguished by three brilliant stars disposed in the form of an arch, and nearly equi-distant from each other.

ANDROMEDA, or Marsh Cistus, a genus of plants belonging to the Decandria class, of which one beautiful species, *polifolia*, is a native of marshy places in Britain.

ANDROPHAGI, an appellation of similar import with Anthropophagi, or *man-eaters*, according to the Greek derivation, was applied, by some ancient writers, to a nation contiguous to Scythia. It has been found to be the practice of many barbarous nations to drink the blood and to eat a portion of the flesh of their enemies taken in war; but otherwise the name is not strictly applicable to any race of human beings who subsist on the bodies of their own species.

ANDROPOGON, or Man's Beard, a genus of plants belonging to the Polygamia class.

ANDROS, or Andro, one of the ancient Cyclades, or cluster of islands in the Archipelago, is conspicuous in history on account of the inhabitants joining the Persians when Xerxes invaded Greece; of their resistance to the Athenians; of their conquest by Alexander the Great, and of their submission to the Roman dominion. This island, which is about 90 miles in circumference, is now subject to the Turks; some parts are mountainous, but the plains are well watered and fertile; it produces grain, wine, and oil, honey, wax, cotton, and fruits; the population, distributed into numerous villages throughout the island, is about 12,000; and it is in N. Lat. 37° 50′ and E. Long. 25° 25′.

ANDROSACE, a genus of plants belonging to the Pentandria class.

ANDRYALA, or Downy Sow-thistle, a genus of plants belonging to the Syngenesia class.

ANDUXAR, or Andujar, a town of the province of Jaen in Spain, stands on a plain on the banks of the Guadalquiver, is adorned with some beautiful churches and religious houses, has a population which exceeds 2000, with some trade in silk; the surrounding country abounds in grain, wine, oil, and fruits; and it is 40 miles east from Cordova.

ANDUZE, a town of the Cevennes, or department of Garde in France, with a population of 5000, and manufactures of woollen stuffs, silk stockings, and hats. It is 27 miles distant from Montpelier, and 21 miles from Nismes.

ANEMOMETER, an instrument for measuring the force and velocity of the wind. See Meteorology.

ANEMONE, or Wind-flower, a genus of plants belonging to the Polyandria class.

ANEMONE, Sea, the trivial name of the genus Actinia, or animal flower. See Helminthology.

ANEMOSCOPE, an instrument for observing the direction of the wind, of which the vane, constructed of a thin plate of metal, moving on an upright rod, and usually fixed on the top of lofty buildings, as spires and towers, is an example.

ANETHUM, Dill and Fennel, a genus of plants belonging to the Pentandria class.

ANEURISM, from the Greek word which signifies *swelling*, is the morbid dilatation of an artery, which for its cure requires a surgical operation.

Angel.

ANGEIOLOGY, derived from two Greek words, which signify *vessel* and *discourse*, is that part of anatomy which treats of the blood-vessels and lymphatics.

ANGEL, an order of created intelligences, superior to man. That there is such an order, we are expressly informed by the inspired writers; and, in reasoning from analogy on the subject, we are led to the same conclusion. So vast is the distance of what is finite and partly material, from what is infinite and wholly immaterial, that to suppose ourselves the next in rank to the eternal and incomprehensible God, would be to admit a chasm in the chain of existence, a chasm not sanctioned by that regular gradation downward from the place which we hold, to that of the passive inanimate objects which are scattered around us. Hence a class of beings, purely spiritual, seems necessary to form the connecting link between us and the great Creator. But though divested of all corporeal substance, as they certainly must be, notwithstanding the Christian fathers and scholastic divines have generally ascribed to them thin, ethereal, or fiery bodies, they have, when occasion required, become visible to man, by the assumption of a human or other appearance.

At what particular period angels were created, we are not told. Yet it is evident they were prior to the formation of the earth; for when the Almighty Architect laid its foundations "the morning stars sang together, and all the sons of God shouted for joy." It is maintained by St Jerome, and the author of the book *De Trinitate*, among the early Christian writers, and by Burnet and Stackhouse, among the moderns, that they were attendants in the court of heaven long before this planetary system sprang from the hands of God. To this it is objected: If the term "beginning," which Moses employs as the date of the creation, signifies the commencement of *time*, and this obviously is the only meaning of which it is susceptible, then to ascend a step higher in the scale of duration is to go beyond the bounds of finitude, and to enter on the regions of eternity; and, accordingly, to deny that angels were produced within the six days on which the other works of God were achieved, is virtually to assert that *a parte ante* they are eternal, an attribute peculiar to deity alone, and altogether inapplicable to limited and dependent beings. Besides, on giving to them such an antiquity, what comes of the argument, so much insisted on in scripture, for the pre-existence and divinity of Christ, "who was before all things," and "without whom was not any thing made that was made?" We must, therefore, either allow that the origin of angels is included in the Mosaic account, or adopt a sentiment which proves too much. Indeed, the most probable opinion is, that they were made on the first day, along with the heavens, and that they were present, chanting their songs of exultation and praise at every successive manifestation of creating power.

According to sacred scripture, the angels, taken collectively, constitute an immense multitude. Daniel in his vision saw "thousand thousands," of them ministering to "the Ancient of Days;" and our Lord declared, that if he chose to decline his sufferings, he could call from heaven "more than twelve legions" of them to his assistance, that is, upwards of 78,000, estimating the Roman legion at 6500 men. Nay, in reference to human arithmetic and human conception, an apostle styles them "an innumerable company."

Different gradations have been assigned to these celestial beings. By the Jews they are arranged into *four* orders, over which Michael, Gabriel, Uriel, and Raphael respectively preside; by Dionysius the Areopagite, and after him the Roman Catholic writers, into *nine* orders, three of which form a hierarchy, namely, seraphim, cherubim, and thrones,—dominions, principalities, and powers,—virtues, archangels, and angels; and by Mr Mede and others into *seven* orders, with an archangel at the head of each, as designed by the seven lamps in the Jewish tabernacle before the mercy-seat, and by the seven spirits of God sent forth into all the earth. But, while the volume of inspiration countenances a diversity of rank and dignity in the angelic host, such distributions and arrangements of them are mere conjectures.

Angels, as the name in the original indicates, are envoys or messengers; and, in various parts of the sacred writings, they are represented, not only as standing before God, performing solemn acts of praise and adoration, but as waiting in readiness to obey his commands. Hence they are called "ministers who do his pleasure," and "ministering spirits, who are sent forth to minister for them who shall be heirs of salvation." In the zealous discharge of their duties, they appeared to Jacob in his dream at Bethel, as "ascending and descending" on the ladder which he beheld stretched from heaven to earth; *ascending*, to bear the prayers of the saints before the throne, and to report the performance of their own services; and, intrusted with fresh commissions, *descending*, to bestow the favours and to execute the mandates of the Most High. It has been an opinion generally received among Jews and Christians, that empires, kingdoms, and individual men have their guardian angels; an opinion by no means unfounded in the word of God, Psal. xxxiv. 7.; Eccles. v. 6.; Dan. x. 3.; Matth. xviii. 10.; Acts xii. 15. The heathens also believed, that nations, cities, houses, and persons have their tutelary *genii*.

Angels, of all the creatures in the universe, have the nearest resemblance to Jehovah; and are, on this account, sometimes denominated *gods*. They are perfect in holiness, having their thoughts, desires, affections, and conduct duly regulated by the laws of righteousness and truth. Their knowledge, resulting from immediate intuition, the disclosures of revelation, and the long experience of nearly 6000 years, is very extensive; but being still circumscribed, there are many things of which they are entirely ignorant; and though not omnipotent, their strength is so prodigious, that no material substance can resist or impede their operations. We read of their bursting open the doors of the prison, of their shutting the mouths of furious lions, and of their quenching the violence of the fiery furnace.

But it must be remarked, that, not long before the fall of Adam, occasioned by their instrumentality, a revolt took place among the angelic spirits; and those who kept not their first estate were expelled from heaven, and consigned to the abodes of misery, where they are reserved in chains unto the judgment of the great day. How many of them rebelled against the Eternal, is a point on which we have no specific information; yet the number must be considerable, since it is sufficient to constitute a kingdom, under the government of a prince, named Satan, Beelzebub, or the Devil. They are distinguished by an apostle into principalities, powers, rulers of the darkness of this world, and spiritual wickednesses in high places. Nor do we know what the particular crime was through which they forfeited their honour and their happiness. It is commonly supposed to have been *pride* or *envy*: the Mahometans say, it was their refusing to do homage to the first man. Yet, of this we are certain, that they are the enemies of all good; that their hearts rankle with the blackest malignity; and that their unwearied study is to produce anarchy, desolation, and wretchedness in the creation of God. The inimitable poet, Milton, in his "Paradise Lost," thus describes the apostasy, character, and punishment of the archfiend and his associates:

The infernal serpent; he it was, whose guile,
Stirr'd up with envy and revenge, deceiv'd
The mother of mankind, what time his pride
Had cast him out of heaven, with all his host
Of rebel angels; by whose aid, aspiring
To set himself in glory above his peers,
He trusted to have equall'd the Most High,
If he oppos'd: and with ambitious aim
Against the throne and monarchy of God
Rais'd impious war in heaven, and battle proud,
With vain attempt. Him the Almighty power
Hurl'd headlong flaming from the ethereal sky,
With hideous ruin and combustion, down
To bottomless perdition; there to dwell
In adamantine chains and penal fire,
Who durst defy the Omnipotent to arms.

But there are some who deny the existence of these wicked spirits, and maintain, that wherever they are mentioned in scripture, we are to understand only a personification of the abstract principle of evil.

ANGEL-FISH, a species of *Squalus*. See ICHTHYOLOGY.

ANGELICA, a genus of plants belonging to the Pentandria class.

ANGELO, MICHAEL, the name of several Italian artists who flourished in the 16th and 17th centuries. The most distinguished were Michael Angelo Buonarotti, celebrated as a painter, sculptor, and architect; and Michael Angelo de Caravaggio, who rose to eminence as a painter. See BUONAROTTI.

ANGELOS, PUEBLA DE LOS, or City of the Angels, the capital of the province of Tlascala in Mexico, is described as one of the most flourishing towns of South America. A spacious square in the centre of the city is occupied on one side by a magnificent cathedral, and on the other three sides by elegant and uniform buildings; and from this square many broad and regular streets proceed in various directions. It contains numerous churches, which are distinguished by their splendour, two colleges, and many convents and nunneries. The population is stated at 60,000, variously occupied in manufactures of cotton cloths, hats, glass, fine earthen ware, swords, soap, and in the coinage of the silver from the mines of Zacatecas, which this town shares with Mexico, from which it is 22 leagues distant to the south-east.

ANGER, a strong emotion excited in the mind, the character of which is a propensity, or feeling, which prompts to repel an injury, and to avenge it on the offending party. When this emotion is restrained in its operation, it is distinguished by the name of *resentment*; but when it bursts out into the determined purpose of inflicting punishment on the offender, it is denominated *revenge*. Moralists and divines have distinguished anger into *deliberative*, or rational, and *instinctive*. The first is an important principle, implanted in the human mind, and intended, by the natural expression with which the emotion is accompanied, to protect from injury, or to denote, by suitable marks of disapprobation, the feeling excited by offences received. The second, or what is called instinctive anger, is a principle which man possesses in common with the inferior animals, and leads to acts of immediate revenge on the objects of offence. It has been observed, that anger is not altogether a selfish passion; for it is excited by the injuries offered to others as well as to ourselves; and hence it seems designed, by the Author of nature, to rouse us to vigorous action, not only in our own defence, but to interest us in the defence and protection of others who are injured and helpless. The emotion of anger, then, is a powerful principle in the constitution of man, and well calculated for his protection, or for the defence of others; but the excess of this feeling, as well as of every other interwoven in the human frame, is blameable and degrading to the character of a moral agent; and in this view the apostolic precept, 'Be ye angry, and sin not,' is to be understood.

ANGERMANNIA, or ANGERMANNLAND, a mountainous province of Sweden, bounded on the north by Lapland and Bothnia, on the east by the gulf of Bothnia, and partly on the west by Norway, contains about 80 square miles. In some places the forests are extensive; and in others the soil is fertile, and produces corn and flax. A river of the same name, one of the largest in the kingdom, and partly navigable, traverses the province. Iron ores are abundant; and some ores of copper have been wrought. The manufacture of linen, and other cloths, has been established on a limited scale; and Hermosand, a small place, is the only town of the province.

ANGERS, an ancient city of France, and capital of the former duchy of Anjou, now of the department of Maine and Loire, stands on the banks of the river Maine, which traverses the city. Angers was the frequent scene of warfare between the French and English; and the ruined towers and mouldering walls of the castle, which was reared on a projecting rock in the 13th century, still attest the strength of its ancient military defences. The cathedral is a magnificent structure, and presents some peculiarities in its architecture which have been greatly admired. The university was established about the middle of the 13th century, and the academy of Belles Lettres towards the end of the 17th century. The population, in the 17th century, amounted to 50,000; but the impolitic revocation of the edict of Nantes, which thinned France of its inhabitants, reduced Angers to 36,000 in 1697; and now it can scarcely reckon more than 30,000. The chief manufactures are linen, woollen stuffs, and wax candles; and white wines, grain, flax, and fruits, are the principal matters of commercial enterprise. N. Lat. 47° 28'. W. Long. 0° 33'.

ANGIOSPERMIA, from two Greek words, signifying a *vessel* and *seed*, is one of the orders of the class Didynamia in the Linnæan system of Botany. See BOTANY.

ANGLE, is the inclination of two lines meeting each other in a point, or the divergence or separation of two straight lines.

ANGLER, a species of fish belonging to the genus Lophius. See Lophius, under ICHTHYOLOGY.

ANGLES, called *Angli* by the Roman historian Tacitus, were an ancient German nation, who migrated to the territories of Denmark, afterwards invaded Britain, and subdued great part of the country, and it is supposed gave the name of *Anglia* or *England*, to the southern division of the island.

ANGLESEA, or ANGLESEY, an island and county of North Wales, is separated from Caernarvonshire by the narrow strait called Menai, and is about 24 miles long and 18 broad. The eastern shores are adorned with elegant mansions and thriving plantations; but the island in general is destitute of wood. The hills, which have no great elevation, are chiefly composed of limestone and argillaceous schistus, and they give origin to numerous small streams which water the vallies.

The soil is fertile, and produces such abundance of grain as to afford, in favourable seasons, a considerable exportation; and the pastures annually supply the English market with 8000 or 10,000 head of cattle, 5000 or 6000 sheep, and an equal number of swine. The population, estimated by the number of houses, in 1563, amounted to about 10,000; in 1776, from a similar estimate, the number had nearly doubled; in 1801 it had increased to nearly 34,000; and, in 1811, to 37,000. The island is divided into 74 parishes, and Beaumaris is the principal town.

Anglesea is the Mona of the ancient Romans, the Mon or Moneg of the Welsh, and was the residence of the chief priest of the Druids before the Roman invasion. In several places circles of stones, which are supposed to be the remains of Druidical monuments, are still visible. The Romans attacked the Druids in their sacred retreat in the 59th year of the Christian æra, vanquished the armies of the Britons, and destroyed the consecrated groves.

The mineral productions of Anglesea form the most important feature in the later period of its history. The discovery of masses of lead and copper, and of an ancient smelting hearth, is an indication of the existence of mining operations in this island at a remote period; but the commencement of the Pary's mountain establishment, in 1768, was the consequence of a new discovery, and has proved to the proprietors one of the most beneficial concerns in the kingdom. The body of Pary's mountain, which belongs to Lord Uxbridge and the Reverend Mr Hughes, and is about a mile in length, is chiefly composed of copper ore, the greatest part of which is dug out in the manner of an open quarry; for the rock of aluminous schistus forms little more than the external covering to the accumulated mass of ore. Two quarries or mines are wrought, and in some places have been carried to the depth of 50 fathoms. Including the smelters, 1300 men were at one time employed at both mines, and from 50,000 to 80,000 tons of ore were annually dug out; but the mines are now far less productive, and scarcely afford occupation to half the number of workmen. The varieties of ores are, native copper, in small quantity; black ore, a mixture of galena, calamine and a little silver; green and blue carbonate of copper; and copper pyrites, which is most abundant. The sulphate of copper, which is dissolved in the water of the mines, is precipitated by means of iron, and affords a large proportion of pure copper, which is carefully collected. Alum and green vitriol are manufactured to a limited extent from the materials furnished by the mines of Pary's mountain.

ANGLING, is the art of fishing with a rod, to which are attached a line fitted with a hook and bait, which latter is either natural or artificial. See FISHING.

ANGLO-CALVINISTS, an appellation by which those members of the church of England are distinguished whose opinions coincide with those of other Calvinists, excepting in matters relative to ecclesiastical government.

ANGLO-SAXON, is an appellation applied to the language spoken by the English Saxons, in opposition to the true Saxon and the modern English. The same designation is given to the people who spoke this language, and who invaded and conquered England after the departure of the Romans. The first invasion of England by the Anglo-Saxons took place in the middle of the fifth century; and, after a struggle of 135 years, when the oppressed and dispirited Britons were driven to the mountainous fastnesses of Cornwall and Wales, seven different kingdoms were at last established, a constitution which is well-known in English history, under the denomination of the *Heptarchy*. The kingdoms of the heptarchy were united, in 827, under Egbert, who was crowned king of England, and the Anglo-Saxon government continued during a period of 239 years, when the Norman race of kings commenced in the person of William the Conqueror, who invaded Britain in 1066, and, after obtaining a complete victory over Harold, established himself on the throne.

ANGOLA, formerly called Abonda, is a kingdom of Africa, stretching 480 miles along the western coast, and between the 8th and 16th degrees of south latitude. Excepting along the sea-coast, Angola presents a mountainous aspect; and in some places the summits of the mountains are so elevated as to be covered with snow in certain seasons of the year. The Danda and Coanza, which are the principal rivers, are of considerable magnitude, and are navigable for thirty or forty leagues from their junction with the Atlantic ocean. The soil on their banks is rich and fertile; in some places it is well cultivated, and yields abundant crops of millet, Indian corn, and other kinds of grain. The chief town of the kingdom of Angola is San Paulo de Loanda, which stands about twelve leagues to the north of the river Coanza in the province of Loanda. It was begun by the Portuguese about 1578, contains some good houses, with a cathedral and convent, and includes a motley population of Christians, pagans, and slaves, amounting to 12,000 or 15,000. It is the see of a bishop, and the residence of the Portuguese governor.

The Portuguese very early established their authority in the kingdom of Angola, and through the influence of their agents, the Jesuits, succeeded in forming alliances with the barbarous native sovereigns, and thus acquired numerous facilities of carrying on trade, and especially the slave trade which was probably one of the chief objects of maintaining a tedious struggle in defence of their settlements. The detailed narratives which have appeared of the transactions of the Portuguese in this part of Africa, are filled with accounts of pretended conversions of the natives to Christianity; of their apostasy to the rites of paganism; of their treacheries and murders; and all this under the formal dignity of history belonging only to civilized nations, while it appears that the people of Angola have made no farther advancement in the arts of life than any other of the African tribes.

ANGOLA, or Pigeon-pea, is a species of Cytisus, the *cytisus cajan*, Lin. which is much cultivated in Jamaica for the table, is equal to the English pea when in the green state, and when it is old forms an excellent ingredient in soups; is sometimes called the *Christmas* pea, from bearing at that season, and sometimes the *seven-years* pea, from the plant continuing productive for that period.

ANGORA, or Angura, the ancient Ancyra, the chief city of Galatia, is a town of Natolia, a province of Asiatic Turkey, and 212 miles E.S.E. from Constantinople. The fragments of broken pillars and marble ornaments, which are seen intermixed with the stones of which the walls and houses are constructed and cemented with mud, present a melancholy picture of the remains of its ancient magnificence. Angora stands in an elevated region, is subject to the Turks, and has been long celebrated for a peculiar breed of goats, which are reared in the vicinity, and produce hair as fine as silk, of which a highly valued woollen cloth is manufactured. The finest kind is reserved for the use of the seraglio of the Grand Signior, and its exportation is prohibited under the penalty of a capital punishment. But 500 or 600 camel-loads of the common sort are annually conveyed to Smyrna, and exported to different countries of Europe. The orchards in the neighbourhood thrive well, and produce pears, which supply the market of Constantinople; and it has some trade in wax and opium, which latter is extracted from poppies cultivated in the surrounding country. The population is stated at 80,000, of which 10,000 are Christians, Greeks, or Armenians, who are chiefly engaged in commercial affairs, and the rest are Turks.

ANGOULEME, a city of France, capital of the former province of Angoumois, and now the chief town of the department of Charente, stands on a rock near the river Charente, contains 16,000 inhabitants, whose chief trade consists in paper, wines, brandy, and salt, and is in N. Lat. 45°. 39′. and E. Long. 0° 14′.

ANGOUMOIS, formerly a province of France, and now constituting the larger proportion of the department of Charente, is bounded on the north by Poitou, and on the south by Perigorde, and produces abundance of corn, wine, and saffron. The brandy, manufactured in large quantities in the vicinity of Cognac, one of the towns of the province, is also a principal source of its trade. In some places iron mines are productive, and a small quantity of antimony has been discovered.

ANGOY, a kingdom on the western coast of Africa, lying between the rivers Cabinda and Zaire, and bounded on the south by Congo. The coast is flat and marshy, but at the distance of a few miles inland the country rises into an elevated region. The inhabitants, although they have some intercourse with the Portuguese and English, who have settlements among them, are still rude, barbarous, and indolent, addicted to idolatry, and indulging in polygamy.

ANGRA, from a word which signifies a *creek*, is the capital of Tercera, one of the Azores, or Western islands, belonging to Portugal, stands on a bay on the south side of the island, is well built, and surrounded with walls, is the see of a bishop, and contains some fine churches, and is a magazine for naval stores to supply the Brazil and East India fleets of the Portuguese. The harbour is safe and commodious in the summer, but in the winter season it is subject to furious tempests. The population is stated at 10,000; and their commercial affairs are limited to the exportation of some corn and a little wine to the Lisbon market. N. Lat. 38° 38′. W. Long. 27° 13′.

ANGUILLA, or Snakes' island, one of the Antilles or Caribbee islands, derives its name from its supposed resemblance to a snake, is about 60 miles north from St Christophers, and is 30 miles long and three miles broad. It belongs to Britain, and was originally settled by the English in 1650. The first settlers were greatly annoyed by French pirates, and afterwards by a party of Irish, who had fled from their native country at the time of the revolution in 1688. The cultivation of the sugar-cane, and the rearing of cattle, are the chief occupations of the inhabitants.

ANGUIS, or Slow-worm, a genus of serpents, which are distinguished from others of this tribe of animals by their sluggish character, which gives origin to the English name. See Ophiology.

ANGURIA, or Water-melon, a genus of plants belonging to the class Monoecia, of which three species have been described. They are cultivated in America and the southern regions of Europe.

ANGUS-SHIRE, a county of Scotland, which is usually described under the name of Forfar-shire. See FORFARSHIRE.

ANHALT, a principality of Upper-Saxony, in the north of Germany, about 60 miles in length and eight in breadth, and lying chiefly between the rivers Elbe and Saal. This district is fertile in grain, and affords a few mineral productions, some of which are the sources of manufactures. The population is estimated at 100,000.

ANHOLT, an island belonging to Denmark, and situated in the Cattegat. The surrounding shoals and sand-banks render the navigation of the seas near this island very dangerous, and have occasioned the erection of a light-house; the exact position of which is in N. Lat. 56° 44′ 20″ and in E. Long. 11° 39′ 51″; ten miles north from Zealand, and eight miles east from the coast of Jutland.

ANJENGO, a small town on the Malabar coast, in the East Indies, which is defended by a fort erected by the English in 1695, is 40 miles north-west from Travancore, and has some trade in long cloths and pepper.

ANIMA MUNDI, or SOUL OF THE WORLD, an imaginary substance among the ancient philosophers, which was supposed to be a pure, ethereal spirit, diffused through the universe, sustaining its various parts, and animating the whole in the same manner as the human soul actuates the body. In some of the ancient systems of philosophy, the soul of the world is considered as a self-existent, intellectual, and eternal principle, the prime mover and active cause of all things in the universe. The human soul was regarded as an emanation from this intellectual principle; and, after death and sufficient purifications, was again restored to its original source. But Plato, who also maintained the doctrine of the soul of the world, ascribed its origin to the Divinity, or great first cause of all things, supposed that the soul which animated the world proceeded from God, and thought that the human soul was derived from it. A doctrine somewhat similar has been revived in modern times under the name of *plastic nature*.

ANIMAL has been defined an organized and living body possessed of sensation. The three great classes of natural objects, minerals, vegetables, and animals, are characterised by Linnæus in the following manner: Minerals grow or increase; vegetables grow and live; and animals grow, live, and have the power of sensation. Later naturalists have divided the objects of nature into two great classes, *organised* or *organic* beings, and *inorganic* bodies. The latter includes minerals; and under the former class vegetables and animals are comprehended. This arrangement furnishes characters sufficiently accurate and precise for the discrimination of minerals, and the two classes of organised beings, vegetables and animals; but the exact definition of vegetables and animals is still wanting. Sensation and loco-motion, ascribed to animals, appear in some degree in certain vegetables; and some animals seem to have the power of sensation and loco-motion in as low a degree as some of the objects of the vegetable kingdom. Mineral bodies are increased by aggregation, by the addition of particles of the same kind of matter as that of which they are composed; but organised bodies are increased by matter of a different kind introduced into tubes or vessels within the vegetable or animal, and by certain processes changed and assimilated to the different parts of the individual. It has been observed by Dumeril, a French naturalist, that the masses in which inorganic bodies present themselves are angular, insulated, and variable in size; that they may be said to be *formed;* and their origin may be traced to attraction. But the individuals called plants and animals have necessarily a form that is constant, for the most part rounded and symmetrical, and their extension is fixed to certain limits; and in increasing their size they only develope themselves. Bodies which increase by aggregation may be divided into very small parts, bearing a near resemblance to the mass from which they are separated; but in plants and animals, which develope themselves, no portion can be taken away and exist by itself, at least unless it develope new parts for the purpose of replacing those that are wanting. But the distinction between vegetables and animals, either from the poverty of language, or the inaccuracy of our knowledge, still remains imperfect; and no definition which assigns the precise limits between those two classes of beings has yet been given.

ANIMAL FLOWER, the trivial name of certain marine animals belonging to the order Mollusca, and class of Vermes, in the Linnæan arrangement. Animal flowers are ranked under three different genera, namely, *Actinia*, *Holothuria*, and *Tubularia*, each of which contains numerous species. The animals of this description are attached by a stem to a particular spot, and in this respect resemble plants; they exhibit somewhat of the form of vegetable flowers, and hence have been denominated *Sea Anemone*, or, from their stinging property, *Sea Nettle*; and they often present the richest and most brilliant variety of colours. See HELMINTHOLOGY.

ANIMALCULE, or little animal, is usually applied to those animals which are invisible to the naked eye, and cannot, therefore, be distinguished and examined without the assistance of microscopes. Animalcules are generally found in water, especially putrid water; and as many of them are developed by the artificial infusions of vegetable and animal matters, they are denominated *Animalcula Infusoria*, or Infusory Animals, by Linnæus, and form the last order of his class of Vermes, under which they may be treated. See HELMINTHOLOGY.

ANIME, a resinous substance, which exudes from the trunk of a large tree, *Hymenæa courbaril*, or locust-tree, a native of Brazil and the West-Indies, is transparent, and of an amber-colour, has an agreeable odour, little or no taste, and dissolves slowly in alcohol and essential oils.

ANJOU, a province of France, part of which is included in the department of Maine and Loire. It is 70 miles long and 60 broad, finely diversified with hills, extensive forests, and fertile plains, watered by numerous streams, and produces grain, fruits, flax, cattle, and sheep.

ANIO, or ANIEN, the ancient name of a river of Italy, now called *il Teverone*, which falls into the Tiber four miles from Rome.

ANISUM, or ANISE, the trivial name of a species of Pimpinella, an umbellated plant, which yields an essential oil.

ANN, or ANNAT, a tax imposed by the see of Rome on all ecclesiastical benefices to which a new incumbent was presented, under the authority of the papal bull. This tax, amounting to a year's revenue, was appropriated to the support of the Sacred College. Sometimes this tax exceeded the amount of the annual revenue of the benefice from which it was levied, and sometimes it was only half that sum. It seems to have varied, according to the influence of the Pope, or his representatives, in different countries.

ANN, or ANNAT, according to the ecclesiastical establishment of Scotland, is half a year's revenue of a benefice to which the heirs or executors of a deceased clergyman are by law entitled. The widow of a clergyman who dies without children has a right to one half of the ann, and his legal heirs to the other. In the case of children, two-thirds fall to them, and one-third to the widow; but if children only survive, the whole belongs to them.

ANNA, one of the chief towns of *Arabia Deserta*, and a great thoroughfare for caravans from Aleppo, Damascus, and Bagdad, stands on the banks of the Euphrates, in an elevated region, which is fertile in corn and fruits, contains about 4000 houses, and is 220 miles south-east from Aleppo, and 260 miles east from Damascus.

ANNABERG, a town of Upper Saxony, is situated in the mountains of Misnia, and not far from the frontiers of Bohemia, owes its origin to the silver mines in the vicinity, and is 38 miles south-west from Dresden, and 14 miles south from Chemnitz.

ANNABON, or ANNOBON, an island on the coast of Loango, in Africa, belonging to the Portuguese, and discovered by them in the 15th century, is in S. Lat. 1° 30′, and E. Long. 5° 40′; yields abundantly all the vegetable productions of tropical climates, is about 30 miles in circumference, and on the north-east side has a convenient roadstead for shipping, with good anchorage.

ANNALS, a species of history, in which the relation of events is arranged in the order of time in which they happened; such, for example, are the *Annals of Tacitus;* and the authors of such works are called annalists.

ANNAMOOKA, or ROTTERDAM, an island in the Pacific ocean. See ANAMOOKA.

ANNAN, a borough town, and the capital of Annandale, a district of Dumfries-shire in Scotland, stands on an elevated bank of a river of the same name, and about a mile distant from its junction with the Solway frith, has many well-built houses, some spacious streets, and a population amounting nearly to 2000, who are employed chiefly in spinning and weaving cotton, in curing pork, and in the exportation of grain, hams, bacon, and hog's-lard to different parts of England. The salmon-fishing, formerly considerable, has greatly declined. Annan is 16 miles distant from Dumfries.

2

ANNANDALE, a district of Dumfries-shire in Scotland, is a fertile valley, traversed by the river Annan, and about 25 miles long and 15 miles broad; from its vicinity to England was subject to predatory incursions, and continued long waste and in a state of commonage, but is now divided, and in many places highly improved, and contains numerous remains of Roman antiquities, as well as many mansions and castles of powerful barons of later times, now in their progress to decay. The great road from London to Edinburgh and Glasgow passes through Annandale.

ANNAPOLIS, the capital of the state of Maryland in North America, stands at the mouth of the river Severn, which was its former name, has a population of 2000, and is distinguished by the state-house, a magnificent edifice, which occupies the centre of the town, and from which the streets branch off in all directions.

ANNAPOLIS ROYAL, assumed this name for Port-Royal in 1713, when it was ceded at the peace of Utrecht by the French to the English, and was thus denominated in honour of Queen Anne, is a small town of Nova Scotia in North America, has some trade in wood, fish, and furs, but is chiefly remarkable for its situation on the south side of a bay which forms one of the most spacious and safest harbours in the world; it is six miles long and three miles broad, and capable of admitting 1000 vessels. The entrance, which is not a mile wide, is difficult, on account of the force of the tides and currents. Annapolis is 80 miles west from Halifax.

ANNEALING, is a process to which glass-ware is subjected to render it less brittle. In the manufacture of all kinds of glass, it is introduced into an oven or furnace, called the annealing or nealing-furnace, the temperature of which is not sufficient to fuse it, and in this furnace it is allowed to cool very slowly. Glass-ware which has not undergone this process, or which has been cooled in the open air, presents some singular properties, which are illustrated by some striking experiments with what are called philosophical phials and glass-tears, or Prince Rupert's drops. The former are made of crystal-glass, are sometimes near an inch thick in the bottom, and may be struck hard on a table or smooth surface without injury. But when an angular bit of flint, a few grains weight, is even cautiously dropped into the inside, they fly to pieces. Prince Rupert's drops are made of common bottle-glass, which is let fall, in a state of fusion, into cold water, and in this way a roundish oblong head, with a long slender tail, is formed. When the least bit of the tail is broken off, while the tear is held in the hand to prevent it from flying about, the whole mass bursts with a smart shock into minute fragments like sand. When they are heated to redness, and allowed to cool slowly in the open air, they acquire the properties of common glass.

When glass passes from the liquid to the solid state by slow cooling, all the parts are uniformly arranged, or are regularly crystallized; and in this state, in consequence of the crystallization, the mass has acquired a greater bulk than in the state of fusion; and then, too, it becomes elastic, and susceptible of long continued vibrations. But the sudden exposure of glass to cold, when passing to the solid state, forms a crust or external covering to the internal parts before they have time to assume a regular arrangement. The internal parts are supposed to be in a state of tension, or compression, from the external crust. When a smart stroke is applied to unannealed glass, as to the philosophical phial, or Prince Rupert's drops, the vibration is instantaneously communicated to the whole mass, and no change is produced; but when the tail of the drop is broken, or the surface of the phial is scratched, the vibration is conveyed along the crystallized surface, and the internal parts are allowed to expand, and thus overcome the cohesion of the outer covering, and burst into pieces. But neither this explanation, nor any other which has yet been offered, is at all satisfactory in accounting for the remarkable difference between annealed and unannealed glass.

Metallic substances exhibit similar differences in their properties. A mass of iron, when hammered, becomes brittle, and requires to be heated to recover its malleable property; and cast-iron vessels, when allowed to cool slowly, acquire considerable elasticity, and are less liable to injury.

ANNECY, or Annici, a town of Savoy, annexed to the department of Mont-Blanc in France, is finely placed on the banks of a beautiful lake of the same name, which is nine miles long and three or four miles broad, is 19 miles south from Geneva, and contains about 5000 inhabitants.

ANNEXATION, in a general sense, denotes the act of uniting one subject to another. In the law of Scotland, this term signifies the union of lands unalienably to the crown. By an act passed in 1455, the annexed royal property was declared to be unalienable without the sanction of parliament; but by subsequent enactments, these precautions were removed, and the property of the crown was completely alienated, with the exception of Edinburgh, Dumbarton, and Stirling castles, and the feu-duties of ancient domains.

ANNEXATION of the *temporality of benefices*, in consequence of the act of the Scottish legislature, includes all church lands which became unalienably the property of the crown, and for the purpose of supporting the royal dignity, with the exception of, 1. Lands previously erected into a temporal lordship; 2. Lands destined to the support of hospitals, and still appropriated to that use; 3. Benefices, the patronage of which, before the Reformation, belonged to laymen; 4. The glebes and manses which belonged to popish churchmen; and, 5. In particular cases, grants of pensions out of benefices.

ANNEXATION, *quoad sacra*, is the union of part of the lands of one parish to another, when such lands are at too great a distance from the parish church. This practice was introduced for the convenience of the inhabitants in attending the ordinances of religion. Annexations of this kind affect only the spiritual concerns of the inhabitants. Their civil connection with the parish from which they were disjoined remains unbroken. The annexed lands are still burdened with the payment of stipend to the clergy of the parish from which they were separated; and they are still liable to be taxed for their former proportion of expense in building and repairing the church and manse of the old parish.

ANNIHILATION is defined the act of reducing a created being to nothing, and has been a fertile subject of speculation among different nations. The Greek philosophers seem to have confined their discussions to the changes and modifications which are constantly observed in the universe, and to have excluded from their consideration every notion of total annihilation. In later times, the possibility or impossibility of such an event has introduced great diversity of opinion among philosophers and divines. Annihilation is regarded by some Christian philosophers as the greatest of all evils; but some eastern nations consider it as the highest degree of felicity, because the soul is delivered from the slavery of continual transmigration. The Persian bramins hold the opinion, that, after certain long periods, the universe, and every created thing which it contains, is to be totally annihilated. But this speculation, like every other in which the terms are not precisely defined, or are imperfectly understood, admits of endless controversy; and perhaps it is beyond the grasp of the human mind.

ANNONA, a genus of plants belonging to the Polyandria class, and including the alligator apple, the custard apple, and the sour and sweet sops of the West Indies.

ANNONAY, a town of Languedoc in France, with a population of between 5000 and 6000, which has been long celebrated for the manufacture of the finest paper in France, or perhaps in Europe.

ANNOTTO, or Arnotto, is a substance which is employed in dyeing a fine red colour, and is obtained from the seeds of a plant, the *Bixa Orellana*, a native of the West Indies and some parts of the American continent. It is sometimes called *Terra Orellana*, and by the French *roucou*, and is in the form of a hard dry paste.

Annotto is prepared by steeping the seeds, separated from the pods, seven or eight days in water, till fermentation commences, and then, by stirring the whole mass, and beating with with wooden stampers to promote the separation of the red skins. The same process is several times repeated, till the whole colouring matter is extracted. The liquor, after being strained, is heated in iron vessels, and throws up a red scum, which is carefully separated, and boiled down to a proper consistence, made up into cakes, wrapped into palm leaves, and in a few weeks is ready for exportation.

Annotto of a superior quality is prepared by the Indians, without the process of steeping or fermentation. The seeds are rubbed between the hands, which have been previously dipped in palm-oil, till the outer coat is separated, and the bright shining paste which remains on the hands is scraped off with a knife, and laid on a clean leaf to dry in the shade.

ANNUALS, or annual plants, are such as spring up, produce seeds, and decay in the same year.

ANNUITIES are periodical incomes, payable from time to time, either annually, half-yearly, quarterly, or at other intervals agreed upon.

The subject of annuities, and topics of a kindred

Annuities.

nature, may date their origin about the middle of the 17th century, when Huygens, and other continental mathematicians, investigated the doctrine of probabilities. The first published discussion on the theory of probabilities is a small treatise by Huygens, entitled, *De Ratiociniis in ludo Aleæ*, which appeared in 1658. This was followed by a small and a little-known work on *Life Annuities*, by the celebrated John De Witt. Dr Halley constructed a table of mortality from observations made at Breslaw, and pointed out how the probabilities of life and death, and the values of annuities and assurances on lives might be deduced from such tables. This memoir appeared in the *Philosophical Transactions* of London for 1693. For the purpose of abridging calculation, M. De Moivre published, in 1724, a treatise on *Annuities on Lives*, in which he assumed the annual decrements on lives to be equal. In 1742, Mr Thomas Simpson elucidated this subject in a more comprehensive manner, and accommodated the formulæ contained in his work on the *Doctrine of Annuities and Reversions* to any tables of mortality. A valuable work, by M. Deparcieux, entitled an *Essay on the Probabilities of Human Life*, appeared in 1764. Dr Price's *Observations on Reversionary Payments*, which was published in 1769, was chiefly intended to fix the principles on which societies might be formed for making provision for the individuals themselves in old age, or for their widows. Mr Morgan's *Doctrine of Annuities and Assurances* appeared in 1779; the 4th edition of Dr Price's work, in 1783, extended the practical application of the principles already established; and *The Principles of the Doctrine of Life-Annuities*, by Baron Maseres, published also in 1783, contributed to throw farther light on the subject. But the latest, and one of the completest works on annuities is *A Treatise on the Valuation of Annuities and Assurances on Lives and Survivorships*, by Mr Milne of the Sun Life Assurance Society, which was published in 1815. Beside the works now noticed, those who are desirous of entering deeply into this investigation, may consult with advantage various Memoirs by Mr Morgan, which are inserted in the *Philosophical Transactions* for 1800, and ten or twelve years preceding.

Annuities are usually divided into such as are in possession, and such as are in reversion; the former being those that have already commenced, and the latter such as will not commence till some particular event has happened, or some given period of time has elapsed.

When an annuity is forborn for some years, or payments not made for that time, the annuity is said to be in arrears.

An annuity may also be for a certain number of years only, and then cease; or it may be without any limit, and may continue for ever, and it is then called a perpetuity.

The sum of all the annuities, for the time they have been forborn, together with the interest upon each after it becomes due, is called the amount.

The present worth or value of an annuity, is the price or sum which ought to be given for it, supposing it to be bought off, or paid all at once.

Calculations of annuities are usually made at compound interest, by means of convenient tables constructed for that purpose, and to calculate any sum without them is nothing more than to show how these tables are formed.

The first thing to be done is to find the amount of L.1, at any rate per cent. compound interest, and then multiply this by the sum of which we propose to find the amount; and first, at 5 per cent. to find the amount of L.1 for any number of years, we have only to state thus; by the rule of proportion, if L.100 amount to L.105, what will L.1 amount to; the answer is, fractionally, $\frac{105}{100}=\frac{21}{20}$, amount for the first year;

$20:21::\frac{21}{20}:\frac{21}{20}\times\frac{21}{20}=\left.\frac{21}{20}\right)2$, amount at the end of the second year;

$20:21::\left.\frac{21}{20}\right)2:\left.\frac{21}{20}\right)2\times\frac{21}{20}=\left.\frac{21}{20}\right)3$, amount at the end of the third year.

In the same manner it appears, that this last amount, improved at interest, in the same way, during the fourth year, will be increased to $\left.\frac{21}{20}\right)4$: at the end of the fifth year it will be $\left.\frac{21}{20}\right)5$; and so on; the amount at the end of any number of years being always determined by applying to the amount at end of the first year, an index or exponent equal to the number of years.

If the rate of interest were 4 per cent. the amount for five years would be represented by $\left.\frac{26}{25}\right)5$; and at 3 per cent. by $\left.\frac{103}{100}\right)5$; respectively.

Ex. 1. Required the amount of L.50 for five years, at 5 per cent. compound interest:

This would be $\left.\frac{21}{20}\right)5\times 50$, and $\left.\frac{21}{20}\right)5 = 1.27628$ = the amount of L.1, and this multiplied by L.50, or $\left.\frac{21}{20}\right)5\times 50=1.27628\times 50=63.814=$ L.63, 16s. $3\frac{1}{4}$d. the amount required.

Ex. 2. Required the amount of L.750, for fifty years, at $4\frac{1}{2}$ per cent.

$100:104.5$, or $\left.\frac{104.5}{100}=\frac{20.9}{20}\right)50\times 750=6774.4725$ = L.6774, 9s. $5\frac{1}{4}$d.

Ex. 3. Required the amount of L.150 for ninety-one years, at 5 per cent.

$\left.\frac{21}{20}\right)91\times 150=12715.0325=$ L.12715, 0s. $7\frac{1}{2}$d.

Ex. 4. Required the amount of L.365, for twenty-five years, at 4 per cent.

$100:104$, or $\left.\frac{26}{25}\right)25\times 365=973.032=$ L.973, 0s. $7\frac{1}{2}$d.

Annuities.

A Table might be constructed to facilitate these operations at different rates per cent.

	Years	2 Pr. Cent.	3 Pr. Cent.	4 Pr. Cent.	5 Pr. Cent.	6 Pr. Cent.
At 2 per cent. $\frac{51}{50}$	1	1.020	...	...	...	...
— 3 do. $\frac{103}{100}$	...	...	1.030	...	...	...
— 4 do. $\frac{26}{25}$	...	...	...	1.0400	...	...
— 5 do. $\frac{21}{20}$	...	...	...	...	1.0500	...
— 6 do. $\frac{53}{59}$	..	...	..	...	. .	1.0600
The same at 2 years would be as follows :						
At 2 per cent. $\left.\frac{51}{50}\right)^2$	2	1.0404	..	...	..	..
— 3 do. $\left.\frac{103}{100}\right)^2$	...	...	1.0609	...	...	..
— 4 do. $\left.\frac{26}{25}\right)^2$	...	...	...	1.0816	...	...
— 5 do. $\left.\frac{21}{20}\right)^2$	...	...	...	..	1.0250	...
— 6 do. $\left.\frac{53}{50}\right)^2$	...	...	...	...	...	1.1236
3 p. cent. 3 p. cent. 4 p. cent. 5 p. cent. 6 p. cent.						
$\frac{51}{50}$ $\frac{103}{100}$ $\frac{26}{25}$ $\frac{21}{20}$ $\frac{53}{50}$	1	1.0200	1.0300	1.0400	1. 050	1.0600
$\left.\frac{51}{50}\right)^2$ $\left.\frac{103}{100}\right)^2$ $\left.\frac{26}{25}\right)^2$ $\left.\frac{21}{20}\right)^2$ $\left.\frac{53}{50}\right)^2$	2	1.0404	1.0609	1.0816	1.1025	1.1236
$\left.\frac{51}{50}\right)^3$ $\left.\frac{103}{100}\right)^3$ $\left.\frac{26}{25}\right)^3$ $\left.\frac{21}{20}\right)^3$ $\left.\frac{53}{50}\right)^3$	3	1.0612	1.0927	1.1248	1.1762	1.19102
$\left.\frac{51}{50}\right)^4$ $\left.\frac{103}{100}\right)^4$ $\left.\frac{26}{25}\right)^4$ $\left.\frac{21}{20}\right)^4$ $\left.\frac{53}{50}\right)^4$	4	1.0824	1.1255	1.1698	1.2155	1.2625

The amount of L.1 annuity may be found nearly in the same manner.—For,

1 year's amount, at 5 per cent. is 1. 1.00000

2 do. do. is $1+\frac{21}{20}=\frac{21^2}{20}-20$ 2.05000

3 do. do. is $1+\frac{21}{20}+\left.\frac{21}{20}\right)^2=\frac{21^3}{20^2}-20$ 3.15250

4 do. do. is $1+\frac{21}{20}+\left.\frac{21}{20}\right)^2+\left.\frac{21}{20}\right)^3=\frac{21^4}{20^3}-20$ 4.310125

5 is $1+\frac{21}{20}+\left.\frac{21}{20}\right)^2+\left.\frac{21}{20}\right)^3+\left.\frac{21}{20}\right)^4=\frac{21^5}{20^4}-20$ 5.525631

These quantities may be calculated separately, but much better by summing this geometrical progression of which the first term is 1, and common ratio $\frac{21}{20}$, then taking for example the fifth of these, multiply the last term by the ratio, and from the product subtract the first term and divide by the ratio minus 1, that is,

$$\frac{\left.\frac{21}{20}\right)^4\times\frac{21}{20}-1}{\frac{21}{20}-1}=\frac{\left.\frac{21}{20}\right)^5-1}{\frac{21-20}{20}}=\frac{21^5}{20^4}-20\text{..............}5.525631$$

This is the amount of L.1 annuity for five years, at 5 per cent. and the amount of any other sum, at the same rate and time, may be found by multiplying this by the sum proposed. *Ex.* 1. L.100, which must be 100 times this, would amount to $\left(\frac{21^5}{20^4}-20\right)\times 100=5.525631\times 100=552.563=$L532 11s. 3d. nearly.

Ex. 2.--The amount at 2 p. ct. for same time would be

$$1+\frac{51}{50}+\left.\frac{51}{50}\right)^2+\left.\frac{51}{50}\right)^3+\left.\frac{51}{50}\right)^4=\frac{\left.\frac{51}{50}\right)^5-1}{\frac{51}{50}-1}=\left(\frac{51^5}{50^4}-50\right)\times 100=5.20404\times 100=520.404=\text{L.}520,\ 8\text{s. }1\text{d.}$$

nearly.

Ex. 3. Required the amount of an annuity of L.50, in 20 years, at $3\frac{1}{2}$ per cent. compound interest.

100:103.5, or $\frac{20.7}{20}$, then $\frac{20.7}{20}$ is the ratio, and

$$\frac{\frac{20.7^{20}}{20^{19}}-20}{.7}\times 50=28.2797\times 50=1413.985=\text{L}1413\ 19\text{s. }8\tfrac{1}{4}\text{d.}$$

Ex. 4.—Required the amount of an annuity of L.80, in 30 years, at 4 per cent. compound interest.

100:104, or $\frac{26}{25}$ is the ratio, then $\left(\frac{26^{30}}{25^{29}}-25\right)\times 80=$ $56.0849377\times 80=4486.795=$L.4486, 15s. 10¼d.

Ex. 5.—Required the amount of an annuity of L.40 in 18 years, at 4 per cent. compound interest, then $\left(\frac{26^{18}}{25^{17}}-25\right)\times 40=25.6454\times 40=1025.826=$ L.1025 16s. 3¾d.

The present value of any sum of money may be calculated for any number of years, at any rate per cent. in a similar manner; that is, any sum which is payable only after a certain number of years.

As L.20 in ready money, at 5 per cent. amount to L.21 in twelve months, so reciprocally, L.21, which cannot be received till the end of one year, are really worth only L. 20. *Example* 1.—Required the present value of L.50, the payment of which is due at the end of one year, it must be multiplied by $\frac{20}{21}$, or $\frac{20}{21}\times 50$, and $\frac{20}{21}=.95238$, then $\frac{20}{21}\times 50=$ $.95238\times 50=47.619.=$L.47, 12s. 4½d. and at the end of 3 years it would be $\frac{20}{21}3\times 50=863838\times 50=$L.43 3s. 10d.

*Ex.*2.—Required the present value of L.246, due at the end of 30 years, at 5 per cent. compound interest. This will be $\left.\frac{20}{21}\right)^{30}\times 246=56.9180=$L.56, 18s. 4½d.

*Ex.*3.—Required the present value of L.239, due at the end of 37 years, at 5 per cent. compound interest: Then $\left.\frac{20}{21}\right)^{37}\times 239=39.3002=$ L.39, 6s.

A table constructed for facilitating these calculations would begin thus: 105:100 or 21:20::1: $\frac{20\times 1}{21}=\frac{20}{21}$, so that the present value of L.1, at the end

of 1 year is $\frac{20}{21}$........ .95238

2 do. $\left.\frac{21}{20}\right)^2$........ .90703

3 do. $\left.\frac{20}{21}\right)^3$........ .86384

&c.

the exponent of this fraction being always the same as the number of years.

At 4 per cent. it will be } 104:100: or 26:25::1:$\frac{25\times 1}{26}=\frac{25}{26}$

For one year is $\frac{25}{26}$........ .961538

2 do. - $\left.\frac{25}{26}\right)^2$........ .924556

3 do. - $\left.\frac{25}{26}\right)^3$........ .888996

&c.

The present value of an annuity is that sum which, when improved at compound interest, would be sufficient to pay the annuity; and the present value of the whole annuity is the sum of the present value of its several payments. When a certain sum of money is received annually, it is called an annuity of so much; if the annual payment be L.1, L.100, or L.300, it is called an annuity of L.1, of L.100, or of L.300.

Now the present value of L.1 annuity, at 5 per cent. for example, and then that sum multiplied into the sum proposed, will produce the present value of that sum.

The present value of L.1 would be } 105:100 or 21:20::1:$\frac{20\times 1}{21}=\frac{20}{21}$

For 1 year it is $\frac{20}{21}$........ .95238

2 do. $\frac{20}{21}+\left.\frac{20}{21}\right)^2=20-\frac{20^3}{21^2}$........ 1.85941

3 do. $\frac{20}{21}+\left.\frac{20}{21}\right)^2+\left.\frac{20}{21}\right)^3=20-\frac{20^4}{21^3}$..... 2.72325

4 do. $\frac{20}{21}+\left.\frac{20}{21}\right)^2+\left.\frac{20}{21}\right)^3+\frac{30^4}{21}=20-\frac{26^5}{21^4}$ .. 3.5459

5 do. $\frac{20}{21}+\left.\frac{20}{21}\right)^2+\left.\frac{20}{21}\right)^3+\left.\frac{20}{21}\right)^4+\left.\frac{20}{21}\right)^5=20-\frac{20^6}{21^5}$ ..

&c. [4.32947

Ex. 1.—Required the present value of an annuity of L.60, for 5 years, at 5 per cent. compound interest, it would be $\left(20-\frac{20^6}{21^5}\right)\times 60=4.32947\times 60=259.7682$ $=$L.259, 15s. 4¼d. And at 4 per cent. the present value of the same sum, for the same number of years, would be, $25-\frac{25^6}{26^5}\times 60=4.4518\times 60=267.1080=$ L.267, 2s. 1¾d.

Ex. 2.—Required the present value of an annuity of L.50, which is to continue 20 years, at 3½ per cent. 103.5 : 100, or $\frac{100}{103.5}=\frac{20}{20.7}=$ the ratio, and also the first term.

$\dfrac{\left(20-\frac{20^{21}}{20.7^{20}}\right)}{.7}\times 50=710.62=$L.710, 12s. 4½d.

Ex. 3.—Required the present value of an annuity of L.30, for 7 years, at 6 per cent.

106:100, or $\frac{50}{53}$ is the ratio, and likewise the first term. Then $\left(50-\frac{50^8}{53^7}\right)\times 30=5.5823815\times 30=167.471445$ $=$L.167, 9s. 5d.

Ex. 4.—Required the present value of an annuity of L.20, to commence ten years hence, and then to continue for 11 years longer, or to terminate 21 years hence, at 4 per cent. Here we must find the difference between the present values of two equal annuities, for the two given times, which is done by substracting the value of the one period from that of the other, and multiplying this difference by the given annuity.

At 4 per cent. the ratio and first term is $\frac{25}{26}$.

Then $\left(25-\frac{25^{22}}{26^{21}}\right)\times 20=$value of one period,

and $\left(25-\frac{25^{11}}{26^{10}}\right)\times 20=$ value of the other;

their difference is $\left(25-\frac{25^{22}}{26^{21}}-25+\frac{25^{11}}{26^{10}}\right)\times 20=$ $\left(\frac{25^{11}}{26^{10}}-\frac{25^{22}}{26^{21}}\right)\times 20=5.9188\times 20=118.366=$L.118, 7s. 3½d. Ans.

Annuities.

Each of these sums forms a geometrical progression, of which the first term and common ratio are the same, being $\frac{20}{21}$: and the sum of the progression is found, as usual, by multiplying the last term by the common ratio, and subtracting the first term; and dividing this by the ratio, minus 1, gives the sum of the series. Now the sum of all these, if extended to infinity, would give the perpetuity; but the powers of this fraction, $\frac{20}{21}$ continually go on decreasing in value, for $\frac{20}{21}=\frac{1}{1.05}$, of which the powers of the numerator are always the same, and those of the denominator continually increasing, evidently decreases the value of the fraction, till at length it may be considered as nothing, when 20 will then remain for the value of the perpetuity.

If the rate per cent. be L. 3, the formula for this will then be $103 : 100 :: 1 : \frac{100\times 1}{103}=\frac{100}{103}$; then $\frac{100}{103}+\frac{100}{103}\Big)2$, for two years, and the sum will be

$$\frac{\frac{100}{103}\Big)3-\frac{100}{103}}{\frac{100}{103}-1}=33\tfrac{1}{3}-\tfrac{1}{3}\times\frac{100^3}{103^2}$$

: where the perpetuity is $33\frac{1}{3}$.

It appears therefore, in every case, that whatever be the rate per cent. the first part of this general formula will always represent the perpetuity.

The amounts of sums of money are often calculated for half-years, and annuities very commonly paid in half-yearly payments, and sometimes quarterly; but the same method of calculation will equally answer this purpose. For if we want to know the amount of L.100 in 20 years, for example, when the interest is at 4 per cent. and convertible into principal half-yearly; considering that 20 years is equivalent to 40 half-years at 2 per cent. interest for every half-year, it will be the same as the amount in 40 years at 2 per cent.; this would be $\frac{51}{50}\Big)40\times 100=2.20804\times 100=220.804=$ L.220, 16s. 1d. the required amount, and is more than it would have been if reckoned yearly by L.1, 13s. 10d.

If an annuity is to be paid half-yearly, it is plain the one-half must be paid after one half-year, and the other half of it at the end of the next; we must therefore multiply the present value of L.1 for twice the number of years given, by half the given annuity. If it were required to find the present value of an annuity of L.50 for 21 years, to be received in half-yearly payments, interest being at 5 per cent. per annum, or at $2\frac{1}{2}$ per cent. every half-year, this appears as follows:

$102.5 : 100$: or $\frac{100}{120.5}=\frac{4}{4.1}$, then $4-\frac{4^{43}}{4.1^{42}}\times 25=25.8206\times 25=645.515=$ L.645, 10s. $3\frac{1}{4}$d., the value required; and exceeds the value when interest and annuity are payable only once a-year by about L.4, 9s. 1d.

These four principles, from which four corresponding tables may be constructed, being brought into one view, if we take, for instance, the term of three years, and the rate of interest 5 per cent. will appear thus:

1st, Amount of L.1, at compound interest for 3 years, $\frac{21}{20}\Big)3$ 1.15763

2d, Amount of L.1, annuity com. interest for 3 years, $1+\frac{21}{20}+\frac{21}{20}\Big)2=\frac{21^3}{20^2}-20$ 3.15250

3d, Present value, of L.1 compound interest to be received at the end of 3 years, $\frac{20}{21}\Big)3$ .... .86384

4th, Present val. of 1*l.* annuity com. interest for 3 years, $\frac{20}{21}+\frac{20}{21}\Big)2+\frac{20}{21}\Big)3=20-\frac{20^4}{21^3}$ 2.72325

These four formulas having all nearly the same *form*, may be retained in the memory with the greatest facility, and the most useful calculations may be readily performed without any reference to tables, which may not always be ready at hand.

From the first and third forms, the results are evidently obtained by raising $\frac{21}{20}$, and $\frac{20}{21}$, to the power represented by the number of years; and, from the second and fourth, the results are obtained by summing as many terms of the two geometrical progressions respectively, as are the same as the number of years proposed.

All these operations become very easy, by using the logarithms.

ANNUITIES, *borrowing upon*, a method employed by government for raising supplies. According to this system, money is raised by borrowing either upon annuities for terms of years, or upon annuities for lives. An annuity for a long term of years, although nearly equal in intrinsic value to a perpetual annuity, meets with fewer purchasers; for as the subscribers to a new loan generally mean to sell their subscription as soon as possible, a perpetual annuity, redeemable by Parliament, is preferred to an irredeemable annuity for a long term of years of equal amount. The former, as its value continues always nearly the same, is a more convenient transferable stock than the latter. Annuities, either for terms of years or for lives, are sometimes granted as a premium to the subscribers to a new loan, in addition to the redeemable annuity or interest, upon the credit of which the loan is supposed to be contracted for, and then they are considered only as an encouragement to the lender.

Annuities for lives are also granted, either upon separate or joint lives. Such annuities are denominated *Tontines*, from the inventor's name. When they are granted upon separate lives, the death of every annuitant relieves the public revenue from his annuity. But when annuities are granted upon Tontines, the liberation of the public revenue does not commence till the death of all the annuitants included in the scheme; and the last survivor succeeds to the whole. Upon the same revenue more money can be raised by Tontines than by annuities for separate lives; for an annuity, with a right of survivorship, is really worth more than an annuity of equal amount for a separate life; and, from the natural confidence of every man in his own good fortune, such annuities generally sell for something more than they are worth; and on this account Tontines are preferred to annuities for separate lives, in countries where this mode of raising supplies is adopted.

ANODYNE, from a Greek word which signifies *without pain,* is the name applied to such medicines as remove or alleviate pain. Of medicines which possess this property, opium, or some of its preparations, are the most certain, and at the same time the most powerful in their effects. See MATERIA MEDICA.

ANOMALISTICAL YEAR, is the period of the earth's revolution from one point of its orbit to another. It is sometimes also called the *periodical* year. On account of the precession of the equinoxes, the period of this year is greater than the tropical year.

ANOMALY, from a Greek word signifying *unequal,* is any irregularity in the motion of the planets, or the angular distance of the sun and moon from their apogee, or of the primary planets from their aphelion.

ANOMIA, a genus of bivalve shells, one of the characters of which is a perforation near the hinge of the lower valve. The fossil species of anomia are not unfrequent in chalk and limestone in Britain. See CONCHOLOGY.

ANOREXIA, or ANOREXY, from the Greek, and signifying *want of appetite,* a disease in which the natural desire for food is diminished, or which is increased to a loathing of food, is to be considered either as an original affection of the digestive organs, or a symptom of some other disorder.

ANOSSI, a province of the island Madagascar. See MADAGASCAR.

ANQUETIL DU PERRON, ABRAHAM HYACINTH, a distinguished Oriental scholar, was born at Paris in December 1735, was admitted, at a proper age, a student in the university of his native city, and soon became familiar with the different dialects of the Hebrew tongue. By the advice of friends, rather than by his own inclination, he commenced the study of divinity; but the bias of his mind still led him to enlarge his knowledge of the Hebrew, Persian, and kindred languages. His frequent visits to the royal library at Paris, in the prosecution of his favourite studies, attracted the notice of some learned men, through whose influence he obtained a small share of royal patronage, in the benefit of a salary as a student of Oriental literature; and about the same time the discovery of some manuscripts in the *Zend*, or Sacred Book, which contains the religious code of the Persians, induced him to form the romantic plan of a voyage to India, for the purpose of collecting the works of Zoroaster, the great Persian legislator; and although the application of his friends was unsuccessful in procuring for him an appointment in an expedition destined for India, which was then in preparation, he was not to be diverted from his resolution; he enlisted as a common soldier, and, with a knapsack on his back, had actually marched from Paris to join the troops which were to sail in the fleet, when, by a second interference of friends who could appreciate and admire the inextinguishable ardour of his mind, a free passage to India was obtained, and a suitable salary for his support was appointed. He arrived at Pondicherry in August 1755; with his usual perseverance soon became master of the modern Persian; and in the hope of acquiring a knowledge of the Sanscrit, he visited Chandernagore. Disappointed of the last object, and after a tedious journey full of perils and adventures, he returned to Pondicherry, and soon after proceeded to Surat, where he enjoyed frequent intercourse with the native priests, and greatly improved his knowledge of the eastern languages.

The war between France and Britain deranged his future plans; and the capture of Pondicherry precluding all hope of a residence at Benares, which he contemplated for the purpose of studying the languages, sacred laws, and antiquities of the Hindoos, he returned to Europe in an English ship, landed at Portsmouth, and having visited London and Oxford, reached his native city in 1762, after an absence of seven years.

Destitute of worldly fortune, but rich in the spoils of Oriental literature, M. Anquetil resumed his station in the royal library, was appointed interpreter of eastern languages, and commenced his labours in arranging the materials which he had collected for publication. His large work, *Zend-Avesta*, or Sacred Writings of the Persians, appeared in 1771, in 3 vols. 4to, and is considered by competent judges a valuable accession to Indian literature. He published various other voluminous works, chiefly connected with the languages, manners, and establishments of eastern countries; and having escaped the storms of the revolution, during which he secluded himself from society, and was entirely occupied in literary labours, he terminated a life of 74 years at Paris in 1805. The ardent zeal, indefatigable industry, and profound research, displayed in a long career of study, throw a bright lustre on his character; but it was obscured by excessive vanity, an unamiable temper, and no small degree of national prejudice.

ANSER, the specific name of the common goose. See ANAS, under ORNITHOLOGY.

ANSERES, one of the orders of birds in the Linnæan classification. See ORNITHOLOGY.

ANSIKO, or ANZIKO, a kingdom of Africa, which is bounded on the north by some of the deserts of Nubia, and on the south by part of Congo. The inhabitants, according to the scanty accounts which Europeans have received of them, are in a state of extreme barbarity, and it is said, but it surely exceeds belief, that they are such cannibals as to have a public market for human flesh; but, without inquiring into the truth of this assertion, it may be well doubted whether a people in a state of such rudeness have any market at all.

ANSON, GEORGE, LORD, a British admiral and circumnavigator, was a native of Staffordshire in England, and was born in 1697; entered early into the naval service, and in his 25th year was appointed to the command of a sloop of war. Promoted soon after to the rank of post-captain, he performed several voyages to North Carolina during the succeeding ten or twelve years, and in this service acquired considerable wealth.

But the arduous voyage in which he circumnavigated the globe forms the most memorable incident of his life. With five ships of the line, and some attendant vessels of a smaller description, placed under his command, he sailed from England in September 1740, for the purpose of attacking the Spanish settlements on the western coasts of America, while Admiral Vernon was occupied on a similar service on the opposite shores of Mexico. In doubling Cape Horn he encountered the most tempestuous weather; a severe gale of forty days duration dispersed his squadron; and the scurvy made dreadful ravages among his men. Having repaired his fleet at Juan Fernandez, he sailed to Peru, and destroyed the town of Paita on that coast; but his diminished numbers and sickly crews prevented any farther attempt in the prosecution of hostilities on land, and induced him to proceed westward across the Pacific ocean in the hope of intercepting the Spanish treasure ship, which passes annually between the Philippine isles and Acapulco. On this passage, the Gloucester, the only remaining ship of his squadron, beside his own, became leaky, and was abandoned; and the united crews, enfeebled by sickness, could scarcely conduct the Centurion to the Ladrone islands. They landed on Tinian to water and refresh; and while the commander and great part of the crew were on shore, a storm arose in which the ship slipped her anchors, and was driven out to the wide ocean. Eighteen days of anxious suspense passed over their heads before the Centurion appeared; and during that period, while their bosoms were agitated with the varying emotions of hope and despair, they had actually commenced the equipment of a small vessel found on the island. With a crew renovated in health and vigour, Captain Anson sailed to Macao in China; on his return he had the good fortune to capture a rish Spanish galleon; and with this prize of immense value, he proceeded to Europe by the Cape of Good Hope, and arrived in England in June 1744, after nearly four years absence. Soon after his arrival he was promoted to the rank of admiral, and appointed a commissioner of the admiralty.

In 1747, while in command of the Channel fleet, the successful capture of six French ships of the line and four East Indiamen, made a large accession to his riches and honours. He was immediately raised to the rank of nobility; in a few years was placed at the head of the naval administration; and at last obtained the chief command of the British fleet. He died in June 1762.

Lord Anson was remarkable for taciturnity and equanimity of mind. Under his authority the discipline of the navy was improved; and the revival of the close mode of fighting, which he accomplished, gave full scope to the undaunted bravery and invincible courage of British seamen. The eventful narrative of his voyage round the world, published under the name of Mr Walter, chaplain of the Centurion, was drawn up from Lord Anson's journal by Mr Benjamin Robins, whose curious experiments and ingenious researches in physical science have raised him to a high degree of celebrity as a natural philosopher; and those readers only who have not perused it need be informed, that the English language can boast of few works of deeper interest.

ANSPACH, a marquisate of Franconia in Germany, is bounded by the territories of Nuremberg, Wurtzburg, and Bayreuth, is about 50 miles long, and presents a mountainous aspect. The soil is light and sandy, but produces grain, pulse, and some tobacco. The vine thrives on the banks of the Mayne, and yields an excellent wine; and the rich meadows afford abundant pasture to a fine breed of cattle. Iron and varieties of marbles are enumerated among the mineral productions; and the inhabitants, who exceed 215,000, beside agricultural affairs, are occupied in the manufacture of woollen cloths, tapestry, hats, silk stockings, porcelain, glass, gold and silver lace, and needles. This territory was assigned to the king of Prussia in 1791, during the revolutionary distribution of the French, formed part of one of the new German kingdoms, and has now probably returned to the sovereignty of its former master.

Anspach is the capital of the marquisate of the same name, is about twelve miles distant from Nuremberg, and is chiefly known as the seat of a porcelain manufactory which was established about the beginning of the 18th century.

ANT, the trivial name of different insects which are arranged under different genera; as the common ant, which comes under the genus *formica*; the lion ant, which belongs to *myrmeleon*; and the white ant, a species of *termes*. See Entomology.

ANTA, or Anten, a small mountainous district on the Gold Coast of Africa, which is about 30 miles in length, and has been dignified with the name of kingdom; but the fertile vallies afford rich fruits, some grain, and abundance of goats and poultry. Canoes 30 feet long, and seven or eight feet broad, formed of a single tree, are made in this province, are capable of admitting a cargo of 10 or 12 tons, and are reckoned superior to any other in Guinea.

ANTAB, or Antiochette, a town of Syria, which occupies two hills and the intermediate valley, is about three miles in circumference, and is watered by a stream, part of which is conveyed by aquæducts to the upper parts of the town. The dwelling houses are erected on the hills, and the shops in the vallies have terraced roofs, through the openings of which, for admitting light, a stranger is struck with the singularity of a crowded street under his feet. Bows and saddles which are in much repute, and a coarse kind of printed calicoes, are the chief manufactures and sources of commercial activity. Antab is 40 miles north from Aleppo.

ANTÆOPOLIS, the ancient metropolis of the Thebaid in Egypt, now reduced to a poor village, which exhibits a sad contrast with the portico of a temple, the only remains of a magnificent structure dedicated to Antæus. A stone which forms part of the covering of the portico is thirty feet long and five feet broad; but the gold and azure colours of the cieling, as they are described by travellers, retain all their original brilliancy.

ANTÆUS, according to ancient mythology, was

Antarctic || Antediluvians.

a giant of Libya, and the son of Neptune and Terra, and was celebrated for his vast strength and his skill in wrestling. Having formed a resolution of erecting a temple to his father with human skulls, he slew all that he met to supply himself with materials. Hercules at last became his antagonist, and perceiving that he derived new vigour from his mother earth every time that he touched the ground, raised him into the air, and squeezed him to death.

Antæus and Atlas are supposed to refer to the same person, from the similarity of the incidents of their lives. They were both sons of Neptune; they were both kings of Mauritania; both were famed for their knowledge of astronomy; both invaded Egypt; and both were vanquished and slain by Hercules.

According to the explanation of Sir Isaac Newton, Ammon, the father of Sesac, was the first king of Libya, or that extensive region which stretches from the confines of Egypt to the Atlantic ocean, the conquest of which was accomplished by Sesac, during his father's reign, about a thousand years before the Christian era. After the death of Ammon, the Libyans were excited to rebellion through the influence of Neptune; Sesac was slain, and an army under the command of Antæus or Atlas was sent to invade Egypt. But Hercules, the general of Thebais and Ethiopia, vanquished and slew Antæus, and thus a second time reduced the whole of Libya. Antæus fell near the spot where the city which received his name was built.

ANTARCTIC signifies what is opposite to the arctic, or north pole, as, the *antarctic* pole, the *antarctic* circle, the *antarctic* regions, referring to the south pole and southern regions.

ANTEDILUVIANS, the human race who lived before the flood. Their history which, according to the most approved computation, embraces the long period of 1656 years, is narrated by Moses within the narrow compass of seven chapters in the beginning of Genesis. While a more detailed account was unnecessary for accomplishing the object he had in view, this is the only authentic information that can be obtained; and inquiry cannot proceed beyond these limits without indulging in doubtful speculation. Following the narrative of the sacred historian, we shall state the facts which he records, with such observations and comments as they may suggest.

Adam and Eve.—In adverting to the primitive inhabitants of the earth, our two great progenitors present the first claim to our attention. On the sixth day from the commencement of the creation, when this terrestrial globe was fitted up as an agreeable residence for man, Adam and Eve were brought into existence, as actors on the mighty stage, and admirers of its rich and magnificent scenery. Unlike their descendants, who enter life in a state of infancy and weakness, they sprang from the hands of their Maker in the fullest corporeal and mental perfection; their bodies possessing all that is exquisite in beauty, proportion, and strength; and their minds all that is vigorous in intellect, noble in sentiment, holy in desire, or pious in feeling. This was the Golden Age alluded to by the writers of classic antiquity, when fidelity and virtue were spontaneously cultivated when the Supreme Judge was sincerely worshipped, and when guilt and wretchedness were unknown.

Yet, high as they stood in perfection, Adam and Eve were still mutable; and in an evil hour, by listening to the suggestions of the deceiver, they disobeyed the divine command, and forfeited their honour and their happiness. Fear and remorse now agitated their breasts, the heavens lowered upon them in darkness, and the fair creation of God denied them its smiles.

> Earth felt the wound, and nature from her seat
> Sighing through all her works, gave signs of woe,
> That all was lost.

Amid their consternation and distress, which, but for some gleam of consolation, would have proved insupportable, the offended Creator made known to them his merciful intentions, in declaring that *the seed of the woman should bruise the head of the serpent*, by whom they had been betrayed into rebellion, and plunged into misery. Having interrogated them on the crime they had committed, and, in anticipation, held out to them the dawn of a brighter day upon the world, he clothed them with *coats of skins*, instead of the *fig-leaves* with which they had been formerly covered; expelled them from the Garden of Eden, where they had enjoyed whatever could gratify the senses, please the imagination, or elevate the soul, and doomed them to drag out a life of anxiety, toil, and pain, until death should reduce them to their original dust. In this melancholy event we recognise the Silver Age of the poets, when the corruption of the human heart began to be displayed.

Different opinions have been entertained respecting the interval between the formation of our primeval parents and their apostacy from God. According to one opinion, they lost their innocency and were banished from paradise in the evening of the very day on which they were made; according to another they fell on the *eighth* day of the world, it being supposed probable that, as the *first* week terminated with their creation, the *second* would terminate with their departure from righteousness. A third opinion is, that they revolted on the *tenth* day, since, in remembrance of that catastrophe, the great day of atonement was observed on the tenth of Tisri, the month with which the Jewish civil year commenced; and a fourth is, that they maintained their rectitude *forty* days, as many of the principal trials recorded in scripture, and especially the temptation of Christ, of whom Adam was a type, lasted a similar period. The first of these opinions, which was adopted by most of the Jews and some of the Christian fathers, is by no means probable, because it crowds too many incidents into a short space, and allows not time sufficient for the multifarious transactions in which they were engaged previously to their violation of the covenant. But which of the other three, or whether any of them be founded in truth, it is impossible to determine, for want of proper data on which to proceed in drawing a conclusion.

Cain and Abel.—Soon after the expulsion of Adam and Eve from the garden, their first son, Cain, whose name denotes *possession*, was born. Looking on him, it should seem, as the promised seed who should vanquish the devil, and repair the ruin he had occasioned, Eve exclaimed in a transport of joy at his birth, "I have gotten a man from the Lord;" or, as it might otherwise be rendered, "I have acquired a man, even Jehovah." No such expectation was formed, or exultation expressed, when she brought forth her next son, whom she called Abel, to signify something *vain*, or transient, probably because she now felt her hopes disappointed with regard to the Messiah's immediate appearance; or, because she was now taught, by bitter experience, that all earthly enjoyments were "vanity and vexation of spirit." The former of these sons was "a tiller of the ground," and the latter a keeper of sheep; and if their employments were different, so also were their dispositions of mind. Cain was fierce, cruel, and dissembling; Abel was gentle, harmless, and open. Cain was abandoned to iniquity; Abel was religious and upright. An event at length occurred which stamped infamy on the character of the one, while it shed a glorious lustre on the character of the other. Each of them, at the time and place appointed, presented his offering to the Lord, but Cain's was refused and Abel's accepted. From that moment sentiments of jealousy began to operate in the bosom of Cain, and, cherishing the most deadly intention against his brother, he proposed to him a walk in the fields, that, removed from human eye, he might the more easily accomplish his sanguinary purpose. Abel, who, on the other hand, beheld him with the tenderest fraternal affection, suspecting no evil, readily complied, and fell a victim to his maddening fury. This fixes the era of the Brazen Age, when men, though as yet not wholly corrupted, became savage in their tempers, and prone to deeds of violence and oppression.

> ——————— *aënea proles*
> *Sævior ingeniis et ad horrida promptior arma,*
> *Nec scelerata tamen.* Ovid.

With the Mosaic account of Cain and Abel, heathen tradition remarkably coincides. Sanchoniatho, in his Phœnician history, tells us that the immediate descendants of the two first mortals, Protogonus and Eon, were *Genus* and *Genea*, a male and a female; and Bishop Cumberland, in his Annotations accompanying his translation of the fragments of that history handed down to us by Eusebius, infers, from various circumstances, that Genus and Genea were Cain and his sister. In the Hindoo mythology the first Menu, surnamed Swayambhuva, or son of the Self-existent, had by his wife Satarupa, besides three daughters, two *sons*, who were particularly distinguished, and, from what is said of the Deity descending from heaven to be present at their offering, it would appear that this distinction was such as marked the respective characters of Cain and Abel. And among the Iroquois Americans it has been believed from time immemorial, that the first woman, after she was seduced from her obedience to God, and, in consequence, driven from Paradise, bore two sons, the one of whom was attacked and slain by the other.

Sign given to Cain.—On the murder of his brother Abel, and the denouncement against him for that nefarious transaction, Cain felt all the horrors of sullen despondency, and exhibited a melancholy picture of misery and impenitence. No relentings seem to have taken place in his soul; the only considerations which extorted a complaint from his hardened breast, were the severity of the punishment to which he was doomed, and the fear of being put to death by any one who might chance to meet him in the way. But as banishment, and labour on an unproductive soil, were all that his sentence imported, the Almighty was pleased to favour him with a sign, or token, sufficient to satisfy his mind that the destruction he dreaded should not overtake him; adding, at the same time, that whoever should do him violence, would expose himself to "sevenfold vengeance." What this sign or token was is unknown, and many are the conjectures to which it has given rise. Some think it was a brand in his forehead; others a particular garment with which he was invested; others a continual shaking of his body; others the blasting of his face with lightning; and others the trembling of the ground under him wherever he went.

Descendants of Cain.—Now we behold this fratricide banished in ignominy from the Schechinah, or symbol of the divine presence, and after wandering about through different tracts of uninhabited country, at length settled in the land of Nod, at a distance from Eden, where, it is generally supposed, he became a worshipper of the sun. By the sacred historian no mention has hitherto been made of his wife, who is now first introduced to our notice at the birth of Enoch; although it is extremely probable he was married before he slew his brother and left his father's house. When his progeny began to multiply, he built a city for them, which he named after Enoch, that, by uniting together, they might be the better prepared to repel the hostile incursions which his guilty conscience led him still to dread. From Enoch sprang Irad; from Irad, Methujael; from Methujael, Methusael; from Methusael, Lamech; and from Lamech, Jabal, who constructed moveable tents, and made improvements in the management of cattle, Jubal, who invented musical instruments, and Tubalcain, who discovered the art of extracting iron from its ore.

If it be true, as Josephus relates, that Cain, instead of improving by the afflictions and trials that attended him in his banishment, gave himself up to all manner of wickedness, enriched himself by rapine and plunder, changed the simplicity of former times, and made choice of the most abandoned for his companions, we may easily judge of the bad effects which his example would produce on the conduct of his offspring. We have every reason to conclude that they became licentious, cruel, rapacious, and vindictive. Indeed Lamech, the first polygamist of whom any account is recorded, seems to intimate as much in the following speech to his two wives, Adah and Zillah: "I have slain, (said he,) a man to my wounding, and a young man to my hurt. If Cain shall be avenged sevenfold, truly Lamech seventy and sevenfold." For whether these words be read *affirmatively* or *interrogatively*, they plainly presuppose that Lamech had been chargeable with murder, but that, being less criminal than Cain, who, unprovoked, had assassinated a brother, he might, with much greater justice, expect the divine protection against his adversaries. His wives, it should seem, were sensible of his guilt, and apprehensive of danger, and such was the argument he employed to overcome their fears.

Seth and his descendants.—From the rapidity with which Moses describes the antediluvian ages, many things must be omitted. In the course of 130 years, Adam unquestionably had other children besides Cain and Abel, before the birth of Seth, a fact which is obviously implied in the sacred narrative. We are told by Cedrenus, quoted by Bishop Patrick, that he had 33 sons and 27 daughters, but any specific enumeration ought to be regarded as merely fanciful and gratuitous. Seth was distinguished for his piety and virtue; and from the appellation Enos, signifying *weakness*, which he gave to his first child, we are led to believe, that he deplored the miserable and helpless condition of mankind in consequence of the fall. It is said, that at this time "men began to call on the name of the Lord;" an expression, the import of which, however differently understood by different interpreters, the original words and the strain of the history determine to be this: "men," that is the progeny of Seth, "began to call themselves by the name of the Lord." Very little is recorded concerning his offspring as individuals, before the flood, if we except the duration of their lives, and the place which they occupy in the genealogical catalogue of the patriarchs, from whom the postdiluvians were to descend. Enoch the son of Jared, and Noah the son of Lamech, are the only two whose characters are mentioned with particular approbation. The former "walked with God," and was translated to heaven without tasting of death; and the latter was righteous, and "found grace in the eyes of the Lord." Of the rest we know, in general, that they were attentive to the duties of religion, and were honest and upright in their moral deportment.

Intermarriages, and corruption.—At length the male descendants of Seth, styled "the sons of God," began to associate with the female descendants of Cain, called "the daughters of men;" and enamoured with their beauty and accomplishments, entered into connubial alliance with them, and by incorporating formed one people. Mr Selden, in his book, *De Diis Syris*, relates, from an eastern writer, that the children of Seth, who had sworn by the blood of Abel, never to leave the mountainous parts of the country which they inhabited, to mingle with the children of Cain, were now induced to violate their oath, by the attractive charms of Naamah, and the delightful music of her brother Jubal. The manner in which they were captivated is thus described by the Poet Milton:—

They on the plain
Long had not walk'd, when from their tents, behold
A bevy of fair women, richly gay,
In gems and wanton dress: to th' harp they sung
Soft amorous ditties, and in dance came on.
The men though grave, ey'd them, and let their eyes
Rove without rein, till in the amorous net
First caught, they lik'd, and each his liking chose.

But from whatever cause the union of these two families may have arisen, it is not surprising that it proved subservient to the most pernicious consequences. And if ever the maxim, that "evil communications corrupt good manners," was verified in actual experience, it was so at this period in an awful degree. An almost universal depravity took place; genuine religion was abandoned for idolatry; and the whole earth was filled with impurity, fraud, rapine, and violence. With this the Age of Iron commenced, which is depicted by Ovid in the following lines:—

Protinus irrumpit venæ pejoris in ævum
Omne nefas: fugêre pudor, verumque fidesque;
In quorum subiere locum fraudesque, dolique,
Insidiæque, et vis, et amor sceleratus habendi.
* * * * *
Victa jacet Pietas; et Virgo cæde madentes
Ultima cœlestûm terras Astræa reliquit.

Giants.—From these intermarriages sprang up a race of giants, who were mighty and renowned for their valorous exploits. Not indeed that giants were never heard of until now, for it seems intimated by the inspired historian, that they existed before Seth's posterity united with the posterity of Cain. And we are informed by Sanchoniatho, that from Genus, or Cain, were descended sons of vast bulk and height, whose names were given to the mountains on which they lived. Hesiod also tells us, in his description of the Brazen Age, that the men of that period were fierce, strong, warlike, and insulting; their hearts being of adamant, their corporeal powers immense, their shoulders broad, and their nervous arms irresistible. But though there were such beings in the earth previous to that alliance, yet, in consequence of it they began to multiply, and to present a more threatening aspect. After all, it is very doubtful, whether by giants we are to understand persons of extraordinary *size*, or persons of extraordinary *wickedness*. Both senses may be included in the term, inasmuch as they would naturally become proud and overbearing on account of their prodigious strength; and they were probably the ringleaders in degeneracy during that period of profanity and crime.

Preaching of Noah.—The antediluvians had reached the highest pitch of iniquity; and the Almighty, provoked to indignation, resolved to destroy them with a flood of water, unless they repented of their deeds, and renewed their allegiance to his law and government. He communicated his intentions to Noah, who, amidst the profligacy of the age, was "a just man, and perfect in his generation, and walked with God." To save him and his family, along with a pair of each species of animals, from the impending ruin, he was directed to build an ark of sufficient dimensions for their accommodation. For 120 years, which were allotted for the raising of this huge structure, Noah was commissioned to forewarn mankind of their alarming situation, and to exhort them to reform their lives, and to supplicate forgiveness ere it was too late. Hence he is styled by an apostle, "a preacher of righteousness;" and indeed all the time he was engaged in preparing the vessel, he may be considered as delivering to them one continued practical discourse. But his ministry among them was attended with no success. Ignorant of the divine power, or perhaps trusting to the unwearied operation of divine grace, they disobeyed his exhortations and counsels, as the result of weak and superstitious fear. And thus "because sentence against an evil work was not executed speedily, their hearts were fully set in them to do evil." Such was the plenitude of their awful infatuation.

Destruction by the Flood.—The ark was at length completed, and the period of God's long suffering patience brought to a close. Noah and his family, with the animals accompanying them, entered this asylum, and the Almighty "shut them in," and sealed up the doors. The fountains of the great deep were broken up, and the flood-gates of heaven were thrown open, through which the rain rushed in cataracts to the earth, to inflict vengeance on the guilty and impenitent sons of men. Behold the miserable victims running in every direction from the fury of that storm which they so lately derided! Some cling to the ark and implore admittance; others repair to the roofs of houses; others climb to the tops of the loftiest trees; and others ascend to the summits of the highest mountains; but the impetuosity of the elements drive them from their stations, and the overwhelming waters swallow them up to rise no more. Amid this wreck of nature, this scene of desolation and of death, Noah and his wife, with his sons and their wives, were upborne on the swelling flood; and while thousands fell on their right hand, and ten thousands on their left, they were shielded by the arm of the omnipotent Jehovah, and were preserved to be the progenitors of a new world. The deluge commenced about the beginning of our November, and lasted one whole year.

This event, so particularly described by Moses, is also alluded to by the writers of heathen antiquity. Berosus, the Chaldean, informs us, that Xisuthrus, (another name for Noah,) was warned in a dream of the approaching destruction of mankind by a flood; that he was ordered to build a ship for the protection of himself, his friends and his relatives, together with fowls and fourfooted beasts; and that, in yielding a compliance with that premonition and command, he, and all that were with him, were saved from the ravaging waters. The same story is related by Abydenus, quoted by Eusebius in his *Preparatio Evangelica*. And, to pass over in silence the inundations which happened in the time of Ogyges and Deucalion, and the traditions of a deluge in almost all nations; the memory of this tremendous catastrophe, as the learned Bryant and Faber have abundantly shewn, pervades the whole of Pagan Mythology.

Religion of the Antediluvians.—From what has been already observed, it is evident that the antediluvians were by no means ignorant of the truths and consolations of the gospel. The prophetic promise of the Messiah was given to our first parents immediately subsequent to their fall, and in the accomplishment of this promise they seem to have firmly believed; for, abstracting from other considerations, on what principle can we account for the death of those animals with whose skins they were covered, but on the supposition that they were slain in sacrifice, as a prefiguration of the death and atonement of Christ? In all probability, no beasts had as yet died of themselves; and it is clear, notwithstanding what has been urged by the opponents of this doctrine, that flesh was not used as food before the grant made to Noah after the deluge.

It has been much disputed whether sacrifices, previously to the flood, were of divine institution; and very learned men have arranged themselves on both sides of the controversy. Dr Spencer, Dr Sykes, Bishop Warburton, and others, have adopted the negative of the question; and they have been ably answered by Dr Kennicot in his *Two Dissertations;* Dr Jennings *in his Jewish Antiquities*; and Dr Magee in his work on *Atonement and Sacrifice.* From the cursory manner in which Moses relates the affairs of the antediluvian world it is not to be wondered at, that he says nothing concerning the appointment of sacrificial oblations. Yet, from some of the incidents which come under his notice, we may warrantably infer, that the practice must have arisen not from human contrivance, but from the positive injunction of heaven. How, otherwise, is it possible to understand why God should have refused the sacrifice of Cain, while he accepted the sacrifice of Abel? That of the former consisted only of inanimate objects, namely the fruits of the earth, as an expression of his gratitude for the bounties of providence, without any reference to his ruined condition, or to the blood of the promised Redeemer; whereas that of the latter, besides inanimate eucharistic gifts, consisted also of the firstlings of the flock, as a burnt-offering, to symbolize that expiation which Christ was to make for sin, when the fulness of time should come. Now, since the divine favour was so signally displayed towards Abel on account of his faith, that faith must have had other grounds than the mere conclusions of his own reason on which to rest; inasmuch as God, who is jealous of his prerogative, would have by no means approved of an act of will-worship. Indeed there is nothing in human nature which could lead men *a priori* to suppose, that the Deity would be pleased with the death of his creatures. The truth then seems to be, that sacrifices originated in a divine command, as early as the first mention of Christ; and hence he is represented in Scripture as a lamb that had been slain from the foundation of the world.

The doctrine of the soul's immortality was also known to the antediluvians. It was intimated by the promise of the Messiah to our primeval parents; for, unless this be allowed, it will be difficult to conceive how that promise could impart any real consolation to their minds, under the sentence of death to which they were subjected. It was intimated by the acceptance of Abel, a little before he fell a victim to the fury of his brother, since this acceptance implied blessings in which he could never have participated had he not afterwards existed in another state. And it was intimated with still greater clearness by the translation of Enoch; because, if this was the reward of his walking with God, then he only exchanged earth for heaven, and time for eternity. Nor at this period were mankind uninstructed in the future judgment of the world; the apostle Jude informs us, that Enoch prophesied of that event.

With regard to the Sabbath, some have denied that it was appointed before the giving of the law. But we are told that "God blessed the seventh day and sanctified it, because that in it he had rested from all his works which God created and made." And besides, without admitting that it was instituted at the creation, it will be difficult to assign any reason for the sacredness of the number *seven*, and the portioning of time by the *septenary* revolution of days, which has universally prevailed among the heathen nations. They could not have borrowed this division from the writings of Moses, to which they had no access; nor could they have been led to it by any observations on the motion of the earth, or of the celestial bodies. It cannot, therefore, be accounted for on any other principle but that of tradition.

Form of government.—If Cain's apprehensions of danger on the murder of his brother, and Lamech's speech to his wives, who were afraid of the vengeance which his crimes might provoke from the hand of justice, be excepted, no traces of a civil polity among the antediluvians appear in the sacred page. Yet as such a polity is necessary for the well-being and comfort of society, it is natural to suppose that they must have had a government under some form or other. This was undoubtedly *patriarchal;* the exclusive power being lodged in the fathers of families. Not only would each father be considered as supreme in his own household, but he would also be regarded as invested with paramount authority by all the families who were descended from him. How long such a form existed, it is impossible to say. It may even be fairly questioned, whether it continued to the time of the flood; because men of superior strength and superior acquirements might, by address or compulsion, have gained an ascendancy over the particular sphere in which they moved. Nay it is not unlikely, that, after the union of Seth's posterity with that of Cain, there was no effective government at all; for then the utmost anarchy and disorder prevailed.

Arts, &c.—Although the inspired records give us little information concerning the antediluvian arts, yet we may decypher, amidst the partial darkness in which they are involved, their rudiments or general character. Doubtless, compared with the perfection at which they have arrived in modern times, by the accumulated experience and improvement of nearly 6000 years, they were then in an infant and unpolished state. Husbandry and pasturage were the first objects which engaged the attention of men. Adam was employed in dressing the garden, Cain in tilling the ground, and Abel in grazing the flock. But agriculture implies the use of implements fitted for the purpose; which probably consisted of shells, sharp-edged stones, or pieces of wood whetted at the point. It was not long, however, before these rude implements were laid aside, when the art of Metallurgy was discovered by Tubal-cain. Architecture, carpentry, and music, were also objects of attention; for we are told that Cain built a city, that Jabal constructed tents, that Jubal taught to perform on the harp and organ, and that Noah erected that immense and complicated fabric the ark. The Arabians ascribe the invention of colours and painting to Naamah, and of letters and writing to Seth. And if we may believe Josephus, Seth and his descendants were well acquainted with astronomy and other useful sciences; and being informed by Adam that the world should be destroyed by water, they set up two pillars bearing inscriptions of their knowledge of these sciences, as monuments to future ages. Whether the antediluvians had any traffic we are not told; yet from the progress they made in the arts, and from the hint given us by the sacred historian concerning the introduction of property, or of exclusive right among them in the time of Jabal, it is very likely that they carried on some kind of trade by barter or exchange. Marriage, instituted by the appointment of God, was restricted to one man and one woman; but the original institution was soon transgressed by Lamech, who married two wives, and thus set an example of polygamy which, perhaps, was generally followed, especially among the posterity of Cain.

Longevity.—When we think of threescore and ten years, the present standard of human life, we are apt to wonder at the vast ages which the antediluvians reached. Lamech, the youngest of them who died a natural death, lived 777 years, and Methuselah 969. In almost perfect coincidence with the Mosaic account, Manetho, Berosus, Mochus, Hestiæus, Hieronymus, and many other heathen historians relate, as Josephus informs us, that the first inhabitants of the earth lived even to 1000 years. The causes which led to their longevity are commonly considered to have been the strength of their corporeal powers, the mild and uniform temperature of the air which they breathed, the sobriety of their habits and simplicity of their diet, and the excellent and invigorating quality of the fruits and vegetables on which they fed. But whatever may have been the proximate causes, the ultimate cause was the will of the Creator, who ordains every thing for the accomplishment of the wisest ends. Thus, provision was made for the more speedy propagation of the species, and peopling of the earth; for the transmitting of religious knowledge in a state of purity, in the absence of written document and memorial; and for making discoveries and improvements in those arts and sciences which were useful for the convenience and comfort of society.

In place of admitting such a longevity to the antediluvians, it has been maintained that their lives ought to be reckoned, not by solar but by lunar years, of about 30 days each; an assertion than which nothing more palpably absurd can well be advanced. For, independently of the consideration that it would be impossible to know when to leave off this mode of reckoning, and to calculate by annual revolutions of the earth round the sun; the ages of the patriarchs, in general, would be reduced to a much shorter term than we ourselves attain; even Methuselah would have been only about 80 when he died. Besides, Enos, at the birth of his first son, would have been seven, and Cainan, Mahalaleel, and Enoch, five years old. To this we may add, that if the years after the flood were also lunar, then Abraham had Ishmael in the 7th, and died, "an old man and full of years" in the 14th year of his age. But enough has been said to refute the lunar hypothesis.

As the lives of the antediluvian patriarchs vary according to the different computations of the Hebrew, the Samaritan, and the Septuagint texts of the Bible; and as there have been advocates for each of these computations, we shall here subjoin the following tables: The *first* column denotes the year of the world when the patriarchs respectively began their lives; the *second*, their ages at the birth of their sons; the *third*, the time they lived with Adam; the *fourth*, the time they lived with Noah; and the *fifth*, the time they lived in all.

I. *Hebrew Computation.*

Adam	1				930
Seth	130	130	800		912
Enos.	235	105	695	84	905
Cainan. . . .	325	90	605	179	910
Mahalaleel .	395	70	535	234	895
Jared	460	65	470	366	962
Enoch. . . .	622	162	308		365
Methuselah .	687	65	243	600	969
Lamech . . .	874	187	56	595	777
Noah	1056	182			

II. *Samaritan Computation.*

Adam	1	130		223	930
Seth	130	105	800	335	912
Enos.	235	90	695	433	905
Cainan. . . .	325	70	605	528	910
Mahalaleel .	395	65	535	583	895
Jared	460	62	470	600	847
Enoch. . . .	522	65	408	180	365
Methuselah .	587	67	343	600	720
Lamech . . .	654	53	276	600	653
Noah	707	500	223		

III. *Septuagint Computation.*

Adam	1	230			930
Seth	230	205	700		1042
Enos.	435	190	495	113	1340
Cainan. . . .	625	170	305	498	1535
Mahalaleel .	795	165	135	823	1690
Jared	960	162		1220	1922
Enoch	1122	165		947	1487
Methuselah .	1287	187		1881	2256
Lamech . . .	1474	188		2039	2227
Noah	1662	500			

Of these three computations, that of the Hebrew is the most generally received, and is supported by the most respectable authorities. If, according to it, we add 600,—Noah's age when he entered the ark,—to 1056, the age of the world when he was born, the period from the creation to the deluge will amount to 1656 years.

Number at the flood.—It is impossible to arrive at any thing like certainty with regard to the population of the antediluvian world; all that can be stated on the subject is merely conjecture. Yet it is certain, from the general term of the patriarchal lives, that the human race at the flood must have been very numerous. Mr Burnet, supposing Adam and Eve to have left, at the end of the first century, 10 pairs, and taking a *quadruple*, instead of a *decuple* ratio, for the succeeding centuries, gives us 10,737,418,240 inhabitants. Mr Whiston, proceeding on the principle, that mankind began to procreate as early as they do at present, and continued as long in proportion to their ages, and fixing, according to fancy, the period of doubling at irregular and assumed intervals, produces 549,755,813,888. Mr Cockburn, again, who adheres to the Septuagint chronology, after having made due allowance for every circumstance, such as the age of puberty, and the time of nursing, &c. brings out, in one table, with 50 for the period of doubling, 429,496,729,600; and, in another table, with 40 for the period of doubling, 54,975,581,388,800. Whatever result may be adopted as the most probable, it will far exceed the present population of the earth, which is computed at 800,000,000.

On this subject the reader may consult with advantage Patrick *on Genesis;* Shuckford's *Connexions*, Vol. I.; Stackhouse's *History of the Bible*, Vol. I.; and Faber's *Horæ Mosaicæ*.

ANTEGO, an island in the West Indies. See ANTIGUA.

ANTEJURAMENTUM, an opposition of oaths, denominated also *juramentum calumniæ*, or oath of calumny, was an oath which the person who brought an accusation, as well as the accused, was required to swear before trial in ancient times. The accuser bound himself to prosecute, and the accused swore, on the day on which he was to undergo the ordeal, that he was innocent of the crime.

ANTELOPE, the trivial name of different species of quadrupeds belonging to the genus *Capra*. See MAMMALIA.

ANTENNÆ, the horns or feelers of insects which are of an articulate and flexible structure, commonly two in number, and found in all perfect insects with six legs; but in such as have a greater number of legs the feelers are either wanting, or there are more than two, as in the crab and lobster. In thickness, length, shape, and structure, the antennæ exhibit as great diversity as in the form and magnitude of the insects which are furnished with those remarkable appendages; and even in the male and female of the same species, a striking difference often prevails. The antennæ of insects have been variously regarded by naturalists, as the organ of feeling, of smelling, of tasting, and of hearing. But of the real use of those organs, the numerous experiments which have been instituted to ascertain it seem to lead to no positive conclusion.

ANTENOR, a Trojan prince, the son of Laomedon, and the younger brother of Priam, is one of the characters who make a conspicuous figure in the Iliad and Æneid, and is supposed to have settled in Italy after the fall of Troy.

ANTEQUERA, or ANTEQUIERA, a town of Grenada in Spain, although it is said to be included neither under Grenada, Cordova, nor Seville, near the confines of which it stands, is divided into the upper and lower town; the elevated division is occupied by the higher ranks; and the lower town, which covers a fertile plain, watered with numerous streams, is the residence of mechanics and farmers. The waters of a lake on the higher region afford salt by spontaneous evaporation in summer; and the wine called *Mountain* is obtained from the vineyards on the mountainous districts to the southward. The population exceeds 19,000.

ANTHELION, from the Greek, signifying in opposition to the sun, is a luminous spot in the heavens opposite to the real sun, and produced by refraction in a peculiar state of the atmosphere.

ANTHELIX, the interior protuberance of the external ear, of a semicircular form in the inner side, and running parallel to the helix.

ANTHELMINTICS are such medicines as are employed for the expulsion of worms. See MATERIA MEDICA.

ANTHEM, a passage selected from Scripture, and set to music, which is performed by alternate singing in the cathedral service, and it was originally applied both to psalms and hymns; but, in a more limited sense, it is restricted to a sacred musical composition, adapted to a particular solemnity. The anthem was first introduced into the reformed service of the church of England in the beginning of the reign of Queen Elizabeth.

ANTHEMIS, a genus of plants belonging to the Syngenesia class, under which genus are included *sweet chamomile, corn chamomile, may-weed, &c.*

ANTHER, or ANTHERA, is that part of the stamen in the flower of plants which is attached to the extremity of the filament, and is easily recognized by the fine dust with which it is covered as the flower advances in maturity.

ANTHERICUM, Lancashire or Scotch Asphodel, a genus of plants belonging to the Hexandria class.

ANTHOCEROS, or HORN-FLOWER, a genus of plants belonging to the Cryptogamia class.

ANTHOLOGY, from the Greek, signifying a discourse of flowers, or a collection of flowers, is an appellation of a collection of the flowers of poetry, or of beautiful passages from different authors; and it is applied also to a collection of epigrams, taken from several Greek poets.

ANTHOLYZA, Mad-flower, a genus of plants belonging to the Triandria class.

ANTHONY'S, ST. FIRE, is synonymous with Erisypelas or Rose, and is supposed to have derived this name from the power of curing this disease which was ascribed to St. Anthony of Padua.

ANTHONY'S, ST. ISLAND, one of the Cape de Verd islands on the western coast of Africa, is a mountainous district, inhabited chiefly by negroes, and produces abundance of rich fruits, with some cotton and indigo.

ANTHONY'S, ST. FALLS, a grand cataract on the river Mississippi, where the whole body of the stream, which is 750 feet in breadth, falls from the height of thirty feet.

ANTHOSPERMUM, Amber-tree, a genus of plants belonging to the Polygamia class.

ANTHOXANTHUM, a genus of plants belonging to the Diandria class; one species, the *odoratum*, or sweet scented vernal grass, communicates the fine fragrance to hay.

ANTHROPOLITE, from the Greek, signifying *stone-man*, denotes a petrified human body. Among the numerous remains of the organized beings of a former world, whether belonging to the animal or vegetable kingdom, the largest and most perfect quadrupeds, and all parts of plants, the stems, the leaves, the flowers, and fruits, have been found in a petrified state; but the discovery of the petrifaction of a human body is a rare occurrence. The petrified human subject, which was found in a limestone-rock in Guadaloupe, in the West Indies, and, excepting the head, was dug out pretty entire, affords one authentic instance of this remarkable change. This curious specimen was transmitted to Britain by the care of Sir Alexander Cochrane, and is now deposited in the British Museum.

ANTHROPOPHAGI, from two Greek words, which signify *man* and *to eat*, is an appellation applied to those nations who are supposed to be cannibals, or feed on human flesh. In considering the probability of any people, even in the most barbarous period of their history, indulging in this practice from choice, and not driven to it by famine, or actuated by a spirit of revenge, it seems to have been seldom taken into view that few animals feed on their own species. It is not easy to see why man, whose resources are more numerous and various than most other animals, should be excluded from the influence of this natural feeling. But after all the learned discussion to which this fruitful subject of controversy has led, it may be fairly doubted, whether those who are desirous of discovering a true race of cannibals have succeeded in their researches either among ancient or modern times.

The fictions and fabled accounts of the poets and historians of antiquity allude to such a practice; and, in the doubtful narratives of modern travellers, it is asserted that, in China, great markets are furnished with human flesh for the better sort of people; that in some parts of Africa, human legs and arms are hung upon wooden shambles, and exposed to sale like butcher-meat; and commanders of armies, when on an expedition, carry with them young women, some of which are daily slaughtered to gorge the appetites of those supposed cannibals. But when this information, and the sources from which it is derived, are strictly investigated, the inquiry traces the practice to the pressure of hunger, the spirit of revenge, or some superstitious ceremony. Prisoners taken in war are the usual victims of this barbarous repast; and in many cases it seems pretty obvious, that the gratification of the passion of revenge in the celebration of this bloody triumph over the dead body of an enemy, is connected with a religious rite, in which the sacrifice of human beings is considered the most acceptable offering to guardian divinities, or to the souls of departed warriors.

ANTHYLLIS, Kidney-vetch, a genus of plants belonging to the Diadelphia class.

ANTIBACCHIUS, a metrical division in ancient poetry, consisting of three syllables, of which the first two are long and the last is short, as *āmbīrĕ*.

ANTIBES, the ancient Antipolis, a sea-port town of Provence, in France. Salted fish forms the chief part of its commerce; the surrounding country abounds with fruits, the climate is genial, and the population is about 3000.

ANTIBURGHERS, a class of seceders in Scotland, distinguished from the burghers by their opposition to the burgess-oath, or that part of it which is connected with religious establishments. But the name is not considered by the class to whom it is applied as their proper designation.

ANTICHORUS, a genus of plants belonging to the Octandria class.

ANTICHRIST, from the Greek, signifying, in opposition to Christ, or assuming his place, is some personage under this denomination, or that of "the man of sin," referred to in Scripture, who should appear in some period of the world, and concerning whom much controversy and diversity of opinion have prevailed in all ages and countries. But the question yet remains unsolved. Some think that the character applied to this personage in Scripture belongs only to the devil, and that he is the true Antichrist. According to some, Antichrist was to be a Jew, and a descendant of the tribe of Dan; while others attribute that character to the Jewish high-priest and sanhedrim. By the divines of the Romish church who have discussed this point, the emperor Caligula is pronounced to be "the man of sin;" but, among protestant divines, this character is generally attached to the pope. Some apply the denomination, not to an individual person, but to a civil or religious establishment, as to pagan Rome, Judaism, or popery; and others think that Antichrist appears in the three great forms of popery, Mahometanism, and infidelity. One author, whose work, it is said, is deposited in the Bodleian library in Oxford, attempted to prove that Oliver Cromwell was Antichrist; and another, at a much later period, regards revolutionary France as "the man of sin," and Bonaparte as the last head of the beast. From all this vagueness and diversity of interpretation of the passages of Scripture to which this subject refers, the sober-minded may perhaps hesitate in adopting any opinion which has yet been offered; and perhaps the expressions which have been so variously explained, ought to be taken in a figurative sense, and applied to the general conduct of men in wilfully resisting and unreasonably rejecting the doctrines and precepts of Christianity.

ANTICOSTI, an uninhabited island in the mouth of the river St Lawrence in North America, is above 100 miles in length from east to west, and about 25 miles in breadth; is covered with pine trees; has a rocky coast; is well supplied with fresh water; and the soil is fertile, but in many places marshy. The shores abound with cod fish, of large size and excellent quality. The beneficent establishment of a family on this island for the purpose of affording assistance to mariners unfortunately shipwrecked on its coasts, which was at one time projected by the British government, has not yet been effected. N. Lat. 49. 30. and between W. Long. 61. 30. and 64°.

ANTICYRA, a city of Phocis on the bay of Corinth, was ravaged by Philip of Macedon in revenge for the sacrilege of the Phocians in seizing the temple of Apollo at Delphi, during the ten years *sacred war*; fell under the dominion of the Romans when their power extended to Greece, and afterwards became famous for its hellebore, a vegetable production of the mountainous districts in its vicinity, and a fashionable place of resort for invalids to whom that medicine was recommended. Asprosprizzia, or *White houses*, is the modern name, and it enjoys some trade in the exportation of corn.

ANTIDESMA, or Chinese laurel, a genus of plants belonging to the Dioecia class.

ANTIGUA, or Antego, one of the British West India islands, is in N. Lat. 17. 30. and W. Long. 61. 30. about 50 miles in circumference, and includes an area of nearly 69,000 acres, of which about 34,000 acres are destined to the culture of sugar and pasture land. Antigua was discovered by Columbus in his second voyage; but it was quite destitute of inhabitants, when some Frenchmen, driven from St Christophers, in 1628, by the Spaniards, sought a temporary asylum in it; and which, it is supposed, the want of fresh water made them abandon in a short time. In 1732, some English families fixed their residence in Antigua, for the purpose of raising tobacco; but, in consequence of a grant from Charles II. Lord Willoughby established a more efficient and more numerous colony, whose prosperity was checked by an invasion of the French and Caribs from Martinique, and their property pillaged and destroyed. Restored to Great Britain at the peace of Breda, in 1668, and aided by the experience of some planters from Barbadoes, who settled in it in 1674, this island, under all its disadvantages, began to rise in value, when the soil was found suitable for the cultivation of the sugar-cane.

The districts on the southern parts of the island are mountainous, but no part of it rises to any great elevation. Two kinds of soil predominate, one of which, a black mould on a subsoil of clay, is rich and fertile, when the crop escapes the severe droughts which are not unusual in the climate of Antigua; and the other, a stiff clay on a marly subsoil, is less productive, and is soon impoverished by culture. No springs but such as yield a brackish water flow in Antigua, and no rivers water its vallies. To compensate for this serious inconvenience, rain-water is collected in large cisterns; and when the rainy season is not unusually abridged, a sufficient supply is obtained. The harbours are safe and commodious. English-harbour, where a royal dock-yard and arsenal have been established for careening and repairing ships of war, is capable of admitting those of the largest class.

St John's is the chief town, and capital of the island, which is divided into six parishes, which are served by five rectors, who are provided with annual stipends from L.660 to L.450 currency. Four Moravian missionaries have four chapels in the island, and nearly 9000 slaves under their ministry; and two preachers of the Methodist persuasion have three places of worship. Some of the white inhabitants are Roman catholics, but have no chapel or resident priest. A governor or captain-general, whose authority extends to several other islands, with a council of twelve members, and an assembly of twenty-five members, compose the legislative body of Antigua. The judicial establishments are assimilated to those of the parent country.

Sugar and rum, the staple productions of Antigua, which, either from ignorance of the culture of the cane, or from the imperfect mode of manufacture, were, in the infancy of the colony, unfit for the British market, are now so much improved as to be equal in quality to similar produce from any other of the West-India islands. The uncertain climate renders the sugar crop precarious; but 17,000 hogsheads, of 1600 pounds each, with the usual proportion of rum, is reckoned an average crop. Some cotton is raised, and dye-woods are enumerated among the exports.

From a census, under the authority of the colonial legislature, in 1811, it appears, that the number of white inhabitants was 2102, exclusive of troops; the number of free persons of colour was 1747, and of free blacks 438; and of slaves 28,317. The slave population, in 1807, when the slave-trade was suppressed, amounted to 30,282, from which it would seem, that a decrease, approaching to a tenth part of the whole, had taken place in three years. But Governor Elliot, suspecting some inaccuracy in the statement, had the enumeration brought down to January 1812, when the number entered at the public office amounted to 30,968, which, with 484 who had obtained their freedom within the same period, shews an actual increase of 1170 slaves since the abolition of the trade in 1807. This corrected statement affords a gratifying prospect to the friends of humanity in the improved condition of the slaves, and must also prove satisfactory to the planter, who sees the number of his labourers increased under his fostering care without foreign importation. The same valuable document notices the progressive approach of some part of the negro population to the rights of citizenship. Of the free black persons, 148 are proprietors of lands and tenements, are under no restriction in the purchase of heritable property or slaves, and have the privilege of voting for the election of a representative in the House of Assembly, in the same manner as white freeholders. Another portion of the same description of persons possesses the same privileges, excepting the right of voting, and the purchase of land exceeding ten acres; and the testimony of all free persons is admitted in the criminal and civil courts of the island. The whole population of Antigua, in 1812, amounted to 35,255; and the estimate of the number of the slaves in 1787, drawn from erroneous information, and stated in the general sketch of America at page 259, must be corrected.

ANTIHELIX, or ANTHELIX, a protuberant portion of the external ear in man.

ANTILLES, the French designation of the West-India islands. By some geographers they are divided into Greater and Lesser Antilles. Cuba, St Domingo, and Porto Rico, belong to the first division, and all the others are included under the second, or the Lesser Antilles.

ANTIMONY, the *Stibium* of the ancients, a brittle metallic substance, which has been long the subject of chemical research, was at one time prohibited from use in France on account of its supposed poisonous properties, and, at another, was regarded as one of the most valuable medicines, is now chiefly limited in its use to the purpose of an alloy with lead in printers types. See CHEMISTRY and MINERALOGY.

ANTINE, FRANCIS D', the celebrated author of a chronological work, was born at Gourieux, in the territory of Liege, in 1688, studied at Douay, and, in 1712, assumed the monastic habit. He taught philosophy for some time at Rheims; and the object of research, in which he was long occupied, as compiler and editor of the *Decretalia* and *Glossarium Scriptorum Medii Ævi*, probably suggested the plan of a most elaborate undertaking, *L'Art de verifier les Dates*, or the "Art of fixing the dates of Events," which he commenced, and had proceeded far in its compilation, when he was seized with apoplexy, which, after repeated attacks, terminated his life, in the year 1746. What was left unfinished by the author was completed, and the work was published. The third edition, in three large folio volumes, which is esteemed the best, was printed at Paris between 1783 and 1787. This valuable work exhibits a chronological view of ancient and modern history, a list of sovereigns or rulers of kingdoms and states, with the time of their accession, a catalogue of eclipses of the sun and moon since the birth of Christ, lists of councils, calendars of saints, with the record of all other memorable transactions from which the date of past transactions may be ascertained.

ANTINOMIANS, from the Greek words signifying "in opposition to the law," are those who deny the obligation of the moral law under the gospel dispensation, or who maintain doctrines which seem to supersede the necessity of good works and a virtuous life in those who profess Christianity. The charge of holding such opinions was brought by Luther against John Agricola and his followers in Germany, in 1538, and this appellation was bestowed upon them by the great reformer. But as they were inferences which were supposed to follow from his doctrine, rather than any positive expression of his principles, the imputation was disclaimed by Agricola, whose opinions did not embrace morality in general, but the laws of the ten commandments, which he considered as addressed to the Jews only, and now superseded by the dispensation of the gospel.

Opinions of a similar character were propagated in England in the time of Oliver Cromwell; and by some of those who maintained them it was expressly declared, that the elect cannot fall from grace, or forfeit the divine favour, and, as their wicked actions are not really sinful, forsaking sin, confession, and repentance are not considered essentially necessary to salvation.

ANTIOCH, an ancient city of Syria, which stood on the banks of the river Orontes, about twenty miles from the place of its junction with the Mediterranean, was built by Seleucus Nicator, received the name from that of his father, and became the residence of the Macedonian princes, under whose dominion that part of Syria was reduced. The wealth and magnificence of this famous city obtained for it the splendid appellation of the Queen of the East, a character which belonged to it for the long period of 1600 years; but from its origin, three hundred years before the Christian era, till its final decay, the records of its history are filled with a crowded detail of the calamities of war, and famine, and pestilence, of civil commotions, fire, and earthquakes, while the inhabitants, during the intermediate gleams of prosperity, when it recovered its splendour, were immersed in every kind of luxury and dissipation. After the fall, or extinction, of the race of its first sovereigns, the Romans, the Persians, the Saracens, and the Turks, became successively masters of Antioch. Having withstood a siege of eight months, it was taken at the end of the eleventh century by the Duke of Normandy, in the time of the crusades; and in 1262 it fell under the dominion of the Sultan of Egypt. It is vaguely stated that the population, in the most flourishing periods of its history, exceeded half a million.

The modern Antioch, which stands on the southern banks of the Orontes, is described by recent travellers in a ruinous condition, the houses built of mud and straw, the streets narrow and dirty, and exhibiting altogether a melancholy picture of misery and wretchedness. It is forty miles southwest from Aleppo. The soil of the surrounding country is fertile, but neglected; and the feeble industry of the inhabitants is limited to the management of a few plantations of vines, olives, figs, and mulberry trees,

ANTIPAROS, the Oliaros of the ancients, is an island of the Grecian Archipelago, and, as the name imports, is opposite to Paros, from which it is divided by a strait, which is scarcely a mile in breadth. It is about sixteen miles in circuit, produces some wine, cotton, and corn, and the greater proportion of the inhabitants, about 400 or 500, is collected in a village at one extremity of the island.

A spacious natural grotto, or cavern, supposed on doubtful authority to have been known to the ancients, and which was brought into notice in the 17th century by an Italian traveller, has given great celebrity to Antiparos, and rendered it an attractive object to future travellers. It was first particularly described by the learned French naturalist, Tournefort, and the visit of Mr Saunders, an Englishman, is minutely detailed in the British Magazine for 1746. But vast and magnificent as this cavern assuredly is, some abatement must be made of the awful horrors and splendid beauties which it exhibits to the intrepid visitant. The entrance is at the side of a low hill in the centre of the island, and the immense excavation is in a mass of limestone, or marble, which is probably the prevailing rock. It is nearly 1000 feet in length, more than 300 feet in breadth in some places, and the deepest part is 250 feet below the surface of the earth. The whole is adorned with innumerable columns and pilasters attached to the sides, depending from the roof, or rising from the floor. These columnar structures owe their formation to the filtration of water, holding lime in solution, through the superincumbent strata, and either dropping from the roof, or passing along the sides, the lime is deposited as the water evaporates, and thus, as the rapidity of the process is greater or less, all the variety of forms is produced.

The older naturalists, in describing stalactitical processes, made a distinction between the columnar mass formed from the roof, and that which arose from the floor of petrifying caves. The first was called *stalactite*, and the last *stalagma*, as having dropped from above. As the process proceeds, the stalactite increasing in length from the roof downwards, and the stalagma by the continued deposition of earthy matter from the water as it drops, shoots upwards, and the two at last uniting, form one entire column.

A stalagmitical concretion, without a counterpart from the roof, has been distinguished by the name of *altar* for a century and a-half, in consequence of a grand celebration of mass which was conducted in presence of the French ambassador to the Ottoman Porte in the year 1673, and an assembly of 500 persons. This magnificent natural altar, the gradual production of many ages, is more than 20 feet in height and not less in diameter. The grotto was illuminated with 100 torches; 400 lamps were kept continually burning during the whole of the impressive ceremony; and an inscription on the base of the consecrated pillar records this remarkable celebration of mass at midnight of Christmas in the year 1673.

ANTIPAS Herod, a son of Herod the Great and of Cleopatra, a native of Jerusalem, was nominated, by his father's first will, the successor to his dominions, but a new destination appointed his brother to share his territory. By the decision of the Emperor Augustus, to whom the disputed right was referred, the greater part of Galilee and the country beyond Jordan fell to Herod. The strength and security of his kingdom were the first objects of his government. He adorned and fortified the principal towns, and built a fine city on the banks of the lake Genneserat, which, in honour of the Emperor Tibeberius Cæsar, was named Tiberias.

The wife of Herod Antipas was the daughter of Aretas, king of Arabia. A passionate attachment for Herodias, his brother's wife, and his purpose of divorcing his own, induced the latter to throw herself under her father's protection. Herod married Herodias, and was involved in a disastrous war of four years duration with the Arabians. The Jewish nation were offended at his marriage, which was considered unlawful; the expression of censure which his conduct drew from John the Baptist, excited the resentment of Herod against that prophet; and, at the instigation of Herodias, John was thrown into prison and beheaded. When Jesus Christ was brought before Herod by the order of Pontius Pilate, he was treated with every mark of indignity, clothed with a white robe as a reproach, and sent back to the governor of Jerusalem.

Herod Antipas, ambitious of the title of king, which his nephew Agrippa Herod had obtained from Caligula, made a journey to Rome to prefer his suit to the emperor. His request of being invested with regal dignity was not only rejected, but he was stripped of his government, banished to Gaul, and died in Spain, where he spent the last days of his life. Mark vii. Luke xxiii.

ANTIPATER, a celebrated Macedonian general, first under Philip and afterwards under his son Alexander the Great, was much distinguished by his prudence, fidelity, and bravery, in the councils and military enterprises of the Grecian hero; and, after the death of Alexander, assumed the government of Macedonia and some contiguous provinces. Antipater was the pupil and friend of Aristotle, and was greatly respected among his countrymen for his literary attainments. He died 320 years before the Christian era.

ANTIPATER, the son of Antipas, governor of Idumea, and the father of Herod the Great, was deeply concerned in the long contested struggle between the brothers, Aristobulus and Hyrcanus, for the office of high-priest in Judea, and, after the restoration of the latter to the pontifical dignity, by the command of Pompey, obtained the chief influence in the direction of Jewish affairs. Julius Cæsar, as a reward for his faithful services, conferred upon him the rights of a Roman citizen, and appointed him to an important official situation in Judea; and in his administration his piety, justice, and patriotism were peculiarly conspicuous. But the Jews became jealous of his power, a conspiracy against his life was formed and discovered; and although the parties concerned were pardoned, they succeeded in bribing a menial servant to destroy him with poison, which was accomplished 43 years before the Christian era.

ANTIPATHES, a genus of zoophytes, including various marine productions, which, from their resemblance to vegetables, are denominated *sea-cypress*, *sea-heath*, and *sea-fennel*. See Helminthology.

ANTIPATHY, derived from the Greek words, signifying *against* and *passion*, is defined a strong aversion which is excited in a sentient being by the presence of certain objects, and is set in opposition to *sympathy*. In attempting to trace the origin of antipathies, moral and physiological writers discover no small degree of diversity of opinion, whether the dislike or painful feeling produced by the sight of certain objects, the smell of some substances, the taste of others, or the hearing of peculiar sounds ought to be ascribed to some instinctive principle, or merely to the power of habit. Some animals, it has been observed, have an antipathy or aversion to the sight of others, as the sheep, which is terrified at the appearance of the wolf; but here a sense of danger begins to operate from the presence of an enemy. In the same way a whole brood of chickens, warned perhaps by the parent, flee for safety when the hawk is seen hovering above them. The aversion to the toad and serpent, which many persons are unable to repress, may proceed from early impressions of the supposed poisonous nature of those animals; and the strong dislike to particular kinds of food, may arise from disagreeable effects formerly experienced from the use of such substances or those of a similar nature. Certain odours may produce, in persons whose sense of smelling is peculiarly delicate, headache and sickness; and, to a nice musical ear, singing out of tune, or the performance on a harsh instrument, is attended with very unpleasant sensations. But the indulgence and strong expression of such aversions render them habitual, and easily excited by association, when similar odours are presented or analogous sounds are heard.

It some cases it may no doubt be difficult to account for the antipathy or dislike which arises from the impression of certain objects on the senses; but in many it may be suspected that it proceeds from caprice, or an affectation of singularity and excessive refinement, as in the instance of a lady whose sense of smelling was so extremely delicate as to be altogether overpowered by the fragrance of a single rose in the same room, and actually fainted away at the sight of an artificial flower.

ANTIPODES, from the Greek words *opposite* and *feet*, is expressive of the position of the inhabitants of the globe who live diametrically opposite to each other. They are under the same meridian and under the same parallels of latitude, but on opposite sides of the equator. The days and nights are of the same length to the antipodes on different sides of the earth, but in opposite seasons. It is noon with the antipodes of the southern hemisphere, when it is midnight with those of the northern; and the longest day of the antipodes of the northern hemisphere is the shortest with those of the southern.

ANTIQUARY, a person who investigates and studies the remains of antiquity, as statues, inscriptions, coins, medals, implements of war and of the arts, edifices public and private, fragments of history, manners, &c. Societies have been established in different countries for the encouragement and prosecution of such researches; but it has rarely happened that institutions of this kind have fulfilled the expectations of the public; and perhaps it requires a much wider range of scientific acquirements than is generally imagined for the successful investigation of the history of remote ages,—a comprehensiveness of view, and a nicety of discrimination, which the admirers of a rusty piece of armour, an old coin, or the insulated fragment of an ancient building, are little aware of, and seldom possess, however pompously they assume to themselves the designation of antiquary.

If indefatigable industry and powerful genius be requisite in the composition of modern history, and in the delineation of modern manners, the materials of which are accessible, how much more necessary is the vigorous exertion of similar talents in rearing a solid and connected superstructure from broken and detached fragments, or what Lord Bacon has forcibly denominated the *wrecks of history*? He who is unacquainted with the general history of an ancient nation, can make no satisfactory progress in studying the manners, the customs, the dress, or the buildings of that nation, and the changes induced by war, emigration or trade. One branch of the objects of antiquarian research serves to elucidate another. The literature of ancient Greece and Rome throws light on the arts and political establishments of these renowned states; and a knowledge of their manners and institutions, illustrates the noble monuments of genius displayed in these historical and poetical compositions which have escaped the ravages of time and the destructive hands of barbarians.

The utility of the study of antiquities, when it is prosecuted with competent talents and rightly directed, is sufficiently obvious, not only in giving consistence and connexion to the history of any ancient people of whose arts or learning memorials are preserved, but it is not less conspicuous in aiding inquiry to retrace to a certain origin many of the institutions of modern nations, and some of the peculiar usages around which time has thrown a dark veil, which can only be penetrated by the reflected light of co-existent objects. The reproach and ridicule to which the labours of the antiquary have been sometimes exposed by those whose objects of pursuit are different, may appear in some degree merited in considering the superficial nature of his researches, which lead to no useful application, and seem to be altogether unproductive. But it ought to be recollected that he who digs the stone from the quarry, although inferior in dignity to the architect who designs and arranges the different parts of a fine edifice, is still a necessary agent in rearing the superstructure; and the mere collector and preserver of a fragment of the wrecks of history may contribute something to its elucidation.

ANTIRRHINUM, Snap-dragon, or Calves-snout, a genus of plants belonging to the class Didynamia, some of the species of which are natives of Britain, and others are the well known ornaments of the flower-garden.

ANTISCII, from two Greek words, signifying *opposite shadows*, is a geographical term applied to the inhabitants of the globe whose shadows at noon fall in opposite directions. The shadow of the inhabitants of the northern hemisphere at noon is projected to the north, and that of the inhabitants of the southern hemisphere towards the south; and they are said to be *Antiscii* to each other.

ANTISEPTICS, a general appellation of those substances which are employed in the preservation of animal and vegetable matters. Saline substances, of which the most common and best known is sea-salt, are applied to this use; but saccharine and aromatic substances are successfully employed for a similar purpose. See DIÆTETICS.

ANTISPASMODICS is a term applied to those medicines which are employed in the cure or prevention of spasms. See MATERIA MEDICA and MEDICINE.

ANTISTHENES, a Grecian philosopher, and the founder of the Cynic sect, flourished about 420 years before the Christian era, was the disciple of Socrates, and seems to have been more anxious to put in practice the precepts of his master with regard to virtue and moderation than to indulge in speculative discussions. But in the exercise of frugality and temperance, his manners became repulsive and morose; and even his indifference in disregarding and despising the accommodations and comforts of life, displayed no small degree of ostentation. "I see your vanity," said his master Socrates, "through your tattered garments."

A place called *Cynosargum*, or the temple of the white dog, without the walls of Athens, was chosen by Antisthenes for his school, from which, as some suppose, the name of the sect is derived; but, according to others, it is indebted for its origin to the snarling and capricious manners of the philosopher.

The unsparing severity with which Antisthenes censured the faults and follies of others, the rigid self-denial which he inculcated, and the moroseness and gloom which overspread all his actions, limited the number of his disciples and followers. Regarding pleasure as the greatest evil, he indulged only in the plainest food, wore a single cloak of the coarsest cloth, and wandered about with a wallet and staff, the whole extent of his property, like a common beggar. He was the author, it is said, of many books; and if the sentiment quoted by Cicero from some part of his works be really his, that "the gods of the people are many, but the God of nature is one," he seems to have held correct notions of natural religion.

ANTITHESIS, from the Greek words which signify to *set opposite*, is the contrast or opposition of words, or expressions, in speaking or writing, for the purpose of marking the difference more strongly. This mode of composition was not uncommon among the ancients, and was very frequent among the older English writers. Cicero affords a good example of antithesis in one of his orations, when he says, "On one side stands modesty, on the other impudence; on one fidelity, on the other deceit; here piety, there sacrilege, &c. The following is an example in poetical composition.

Tho' deep, yet clear; tho' gentle, yet not dull;
Strong, without rage; without o'erflowing, full.

ANTITRAGUS, a protuberance of the cartilage of the external ear in man.

ANTONINUS PIUS, a celebrated Roman emperor, was descended from a noble family in Gaul, and was born at Lavinium, near Rome, in the 86th year of the Christian era. His father and grandfather had enjoyed the consular dignity, and his maternal grandfather, under whose care he was educated, had risen to the same distinguished rank. Possessed of great wealth and influence, which he derived from his rich and powerful relations, he was called to fill various official situations in the state; in the year 120 was appointed consul, became afterwards proconsul of Asia, and in 138 was adopted by Adrian as his successor. The death of Adrian in the following year opened his way to the throne, and he assumed the reins of the imperial government amid the undivided acclamations of the senate and people. The mildness of his character, or his regard for religion, obtained for him the sirname of *Pius;* he merited and was honoured with the titles of *High Pontiff*, and *Father of his Country;* and the prudence, equity, and disinterestedness which marked his administration, and the peace and prosperity which his government secured to the empire, shewed that he was worthy of such distinguished appellations. He resided almost constantly in his capital, and although he was anxious to avoid laying new burdens on the people, and frugal in the public expence, yet he was liberal in gratifying the desires of his subjects for shews and spectacles; and he erected various ornamental and useful public edifices, among which are enumerated the temple dedicated to his predecessor, Adrian, in Rome, and the magnificent structures of the amphitheatre and aquæduct at Nismes in France.

The celebrated wall, of which some remains are still visible, and which extended from the Frith of

Forth to the river Clyde, in Scotland, was erected about the year 140 by the orders of Antoninus. The modern appellation of this rampart is *Graham's dyke*, supposed to be corrupted from *Gryme* or *Grym*, which signifies *strong*, or is the name of the warrior who made an irruption into the Roman territory. When this great military structure was entire, it consisted of a ditch 40 feet wide and 20 feet deep, and a rampart on the south side 24 feet thick and 20 feet in height, with a military way behind it. The whole length exceeded 36 miles; and as a defensive work against the Scots and Picts, which was the object of its construction, it was strengthened by 21 forts, which are supposed to have been erected by Agricola. The materials of which the rampart was composed, seem to have been dug out of the ditch on the north side; for when it passes through rocky strata the proportion of stones is increased. But for a fuller description of this famous wall, the reader may consult Gordon's *Itinerarium Septentrionale*, Horsley's *Britannia Romana*, or Roy's *Military Antiquities of the Romans in North Britain*.

The wife of Antoninus was Annia Faustina, the daughter of Annius Verus, a woman of licentious character, to whom the weakness or indulgence of a husband, who survived her, permitted divine honours to be paid after her death. Two sons and two daughters were the offspring of his marriage. The sons died in early life, and the younger daughter, Faustina, was married to Marcus Aurelius, who, at the desire of Adrian, was adopted by Antoninus, and succeeded him on the imperial throne. After a pacific reign of 23 years, Antoninus died in the 75th year of his age. Accompanied by the most splendid funeral ceremonies, his body was consigned to the tomb of Adrian, and divine honours were paid to his memory.

ANTONOMASIA, a form of expression, in which an official or professional denomination is put for a proper name, or a proper name is put in place of an appellative; as when the king is called his *majesty*; the *philosopher*, for Aristotle; the *orator*, for Cicero; or when a grave man is called a *Cato*, and a wise man a *Solomon*.

ANTRIM, a county in the province of Ulster, in Ireland, bounded on the north by the northern ocean, on the east by the Irish channel, on the south by the county of Down, and on the west by Lough Neagh and the river Bann; is about 56 miles in length and 30 miles in breadth, and includes an area of 970 square miles. The mountainous districts of this county are towards the east and north, but no part of the elevated land rises to a great height. Knocklayd in the north, Slenish in the middle of the county, and Devis, near Belfast, are the principal mountains. The prevailing rocks in the county of Antrim are basalt, limestone, and in some places sandstone. Gypsum is dug out, for exportation, near Belfast; coals have been long wrought at Ballycastle, on the northern coast; the shores of Lough Neagh furnish masses of petrified wood; and pearlstone, a rare mineral production in the British islands, is found at Sandy Brae, 20 miles from Belfast. But the stupendous range of basaltic strata, exhibiting, in many places, magnificent colonades, particularly at the celebrated Giants' Causeway, and stretching almost the whole length of the northern coast, forms the most striking object to the geologist. The northern and eastern districts are destitute of wood, and much of the low grounds is covered with marshes; but in the southern parts of the county the surface is clothed with thriving plantations, and the soil is richer, more fertile, and better cultivated. The Lagan, which falls into the sea near Belfast, is part of the southern boundary, and is navigable to a considerable distance inland, and the Bann, famous for its salmon-fishery, are the chief rivers. The principal towns are Belfast, Carrickfergus, Lisburn, Ballimena, and Ballimoney. Cairns, cromlechs, and mounts, are enumerated among the remains of antiquity in Antrim; and three round towers, those singular structures, the purposes of which have hitherto baffled the researches of antiquaries, are yet to be seen in the county.

Population, manufactures, &c.—In 1788, the population was estimated, perhaps on vague authority, at 160,000; but, according to the *Statistical Survey* of Mr Dubourdieu, the county of Antrim contains 240,000 inhabitants, many of whom are descended from natives of Scotland. No county in Ireland includes a larger proportion of presbyterian protestants. As the manufacturer and tiller of the ground are often united in the same person, the farms are small, and agriculture has not reached its highest degree of improvement. Flax, potatoes, barley, and oats, are the chief crops. The cattle are of small size; the mountainous pastures feed numerous herds of goats; and the rearing of swine is extensive and profitable. Seventy thousand, of 200 pounds each, have been exported from Belfast during the salting season in a single year.

The staple manufacture of the county of Antrim is linen, which has long flourished; but has given place to that of cotton, which occupies between 20,000 and 30,000 of the inhabitants in the vicinity of Belfast and the surrounding country. Kelp is manufactured on the shores of Antrim, and at Carrick-a-rede, a singular spot on the eastern coast, an extensive salmon fishery is successfully prosecuted. A frightful chasm, sixty feet in breadth, separates the island from the mainland; and to facilitate the communication for the convenience of the fishery, a bridge, formed of strong ropes, covered with boards, is annually constructed.

Rathlin island, five or six miles long, and nearly a mile broad, which lies a few miles off the northern coast, is included in this county. The prevailing strata are limestone; the inhabitants are estimated at 12,000; and they are occupied in agriculture, fishing, and the kelp manufacture. To Antrim also belongs Ram island in Lough Neagh, on which one of the round towers of doubtful origin and use, already alluded to, is erected.

The assizes, elections, &c. are held at Carrickfergus, and the quarter-sessions at Antrim. Five members are returned from this county to the Imperial parliament, two of whom are chosen by the county, and one each for Belfast, Carrickfergus, and Lisburn.

ANTRIM, a town of the county of the same

Antwerp.

name in Ireland, enjoys a fine situation on the banks of Lough Neagh, is 84 miles north from Dublin, and 12 miles north-west from Belfast; the inhabitants are chiefly engaged in the linen manufacture; and the surrounding scenery is adorned with the beautiful domain of the Earl of Massareene.

ANTWERP, a city of the Netherlands, and included in the new kingdom of that name, stands on a wide plain on the eastern bank of the Scheldt, is seventy-five miles south from Amsterdam, and twenty-five miles north from Brussels; and from its local position, with ready access to the ocean on one hand, and an easy communication with the interior of the continent by means of rivers and canals on the other, has often risen to the highest commercial prosperity. About the middle of the 15th century the trade of Antwerp was extremely limited; but, towards its close, it became the rival of Bruges, afterwards the emporium of the Portuguese trade to the east, and, by the establishment of great fairs, attracted mercantile adventurers from every part of Europe. In the middle of the 16th century, 2000 vessels have been seen at one time in the port of Antwerp. But the wars of the Low countries checked its growing prosperity, the persecution of the Protestants drove many of the most enterprising inhabitants to seek an asylum in England and Holland, and the commercial influence of the Dutch cut off its communication with the ocean by means of the Scheldt. Excluded from foreign commerce, the industry and resources of the inhabitants were directed to manufactures. Lace, tapestry, silk, and woollen stuffs, and an extensive hat manufactory, occupied a considerable proportion of the population; and the establishment of banking and assurance societies has been long an abundant source of profitable speculation. The occupation of Antwerp by the French during the revolutionary war, and the unrestricted navigation of the Scheldt, gave a temporary activity to the commerce of Antwerp, and its local advantages seemed favourable to the ambitious schemes of Bonaparte, who had projected many great works for its improvement, and had selected it as one of his chief naval arsenals, for which purpose the breadth of the river, which is nearly half a mile, and the depth of water from 20 to 40 feet, render it peculiarly appropriate.

The streets and squares of Antwerp are numerous, and many of them are spacious and elegant. The public edifices are distinguished by their magnificence; the exchange is a superb structure; and the cathedral is a noble pile, with one of the finest steeples in the world. The abbey of St Michael, and some of the other churches, are enumerated among the splendid ornaments of the city; and the storehouses and cellars connected with the house of the Hanse towns, which were filled with all kinds of merchandise, in the flourishing period of its history, are altogether unequalled in any other commercial city. Antwerp is surrounded with strong walls, and defended by a citadel, which were erected about the middle of the 16th century. The reverses to which this city has been subjected, have been particularly marked in the decline of its population, which, in the height of its commercial prosperity, was estimated at 100,000, and even double that number according to some calculations. It had decreased to 50,000 a few years ago; but the re-establishment of peace will give new vigour to the enterprise of the inhabitants, and in a short time add to their number.

Anubis || Anvil.

ANUBIS, an Egyptian deity, worshipped under the figure of a man with the head of a dog, is supposed to be a symbolical image, derived from astronomical observations, and intended as a sensible expression of certain appearances or changes of the heavenly bodies. The mythological history of Anubis has been variously explained, both by ancient and modern writers. The Egyptians worshipped the sun under this name when he appeared in the horizon, or at his rising and setting; and to denote the glowing beauty of the morning and evening, the image of Anubis was of pure gold. The dog, the emblem of fidelity, was consecrated to Anubis, because that deity, the symbolical representation of the horizon, is the faithful attendant of Isis or Nature, seeking her lost Osiris, or the sun. The diminished solar influence, in winter, was represented by processions, in which the priests, with tears and lamentations, carried about the images of Isis and Anubis; and Isis, by the help of Anubis, having recovered Osiris, the discovery was celebrated with every expression of joy and exultation.

ANVIL, a solid mass of iron, of a square form, on which malleable metals are hammered. Cast-iron anvils are sometimes employed, but when a bright surface and great hardness are required, forged iron, faced with steel, is preferred. The forge for the construction of anvils is similar to the common smith's forge, but with single bellows; and coak, which affords a strong heat and produces little flame, is used for fuel. A crane, which moves on a pivot, and transfers the red hot masses of iron from the fire to the anvil, is fixed near the hearth. The anvil is a mass of cast metal, raised about a foot from the ground, and eighteen inches square on the face.

The common smith's anvil is composed of seven pieces; the body, or core; the four corners, for enlarging the base; a projection at one end, in which a square hole for a chisel is formed; and a beak of a conical shape, for rounding hollowed work. The body is formed by welding several smaller masses together, and when it is heated for the purpose of uniting the other pieces, three holes, about one inch square and two inches deep, are first made, one in the bottom and one at each end, for inserting a bar of iron connected with the crane, and thus enabling the workmen to manage the heated mass. The different pieces are separately welded to the core, and when they are large two hearths are requisite. All the pieces being united, the heating and hammering are repeated till the anvil has acquired its proper shape.

Facing with steel is the next operation. A plate of steel, as thin as it can be firmly welded, for when it is too thick it is liable to crack in the hardening, is first prepared, of the size of the anvil. The anvil is brought to a strong welding heat in one fire, and the steel is heated in another, but to an inferior degree. The masses being heated, the uniting surfaces are brushed, laid together, and rapidly hammered. In the process of hardening, the face of the anvil is brought to a full red heat, and suddenly plunged and moved about in a large quantity of water, or, what answers the purpose of cooling better, exposed to a copious stream. The face is then ground perfectly even; and when it is intended for the planishing of metals, it must be finely polished with emery and crocus.

ANVILLE, John Baptiste Bourignon, D', a celebrated geographer, was born at Paris in July 1697, discovered at a very early age a strong passion for the study of his favourite science, and even in his twelfth year, while he was engaged in reading the classic authors, he began to construct maps for the illustration of the countries to which they refer; and such was his successful application, that the maps, which he delineated and published about the twenty-second year of his age, were universally admired.

The elucidation of ancient geography occupied a large share of the industry of D'Anville; and as his materials were chiefly drawn from books of history and travels, his indefatigable labour in collecting them, and sound judgment and nice discrimination in their arrangement and distribution, were conspicuous in all his works, and in a remarkable degree supplied the want of astronomical observations and geometrical measurements. Of the numerous maps which he published many are accompanied with memoirs, detailing the authorities on which he proceeded in their construction. Towards the close of a long life he was admitted to share those honours which are connected with the associates of learned societies. He became a member of the Academy of Inscriptions and Belles Lettres, and contributed many memoirs to their transactions; he was nominated to fill the only place in the Academy of Sciences which is appropriated to the science which he cultivated and adorned, and about the same time he was appointed geographer to the king. The valuable and extensive collection of charts and maps which D'Anville had made in the long course of his study was purchased by the king, and it was the last undertaking of the laborious geographer to arrange it. This task was scarcely completed when his mental vigour declined, and, having reached the 85th year of his age, he died in January 1782.

With a feeble constitution, but with temperate and regular habits, united to great gentleness and mildness of character, D'Anville was able to devote, during sixty years of his life, from twelve to fifteen hours of daily application to study. His recluse manners, and undivided attachment to one pursuit, seem to have contracted his views, for he rarely took part in conversation, excepting on the subject of geography, and here he was impatient of contradiction, and is charged with rudeness in expressing his opinion on controverted points. His *Ancient Geography*, 3 vols. 8vo. is one of the most popular of his works.

ANZIKO, a kingdom on the western coast of Africa. See Ansiko.

AONIDES, an appellation of the muses, which is sometimes employed by the poets of antiquity, and is derived from Aonia, a district of ancient Bœotia. *Aonian* grove and *Aonian* spring have a similar origin.

AORIST, from the Greek, and signifying *without limitation*, is a tense in verbs which is understood by some grammarians to be expressive of an action *indefinitely*, without regard to past, present, or future time, but it is usually restricted to indefinite *past* time. The Greek verb has two aorists, the first, according to some writers on grammar, denoting past time generally, and the second signifying indefinite past time; while others maintain that both have the same meaning, and that the second Greek aorist is the imperfect of some obsolete theme of the verb, and is altogether redundant.

AORNUS, or Aornos, a hill fort in the vicinity of Bijore, in the East Indies, holds a conspicuous place in ancient history on account of the brave defence of the natives when they were attacked by Alexander the Great, and the repulses which his army, unused to defeat, experienced before he obtained possession of the place; and this he effected only by artifice and treachery. This fortified rock is described as being 25 miles in circumference, and about a mile and a half in height. A narrow path leads to the summit, which is partly arable land, and partly covered with dense woods.

AORTA, the great artery which conveys the blood from the left ventricle of the heart, and by its numerous ramifications distributes it to every part of the body. From its origin in the heart to the arch which it forms when it passes downwards, it is called the *ascending* aorta; and from the arch to the division into the iliac arteries, it is denominated *descending* aorta.

AOSTE, or Aousta, the *Augusta Prætoria* of the ancient Romans, because a colony of 3000 Prætorian soldiers was settled in it by Augustus, in place of the native inhabitants, who were sold as slaves, is a town of Piedmont in Italy, and was formerly the capital of a duchy of the same name; stands on the river Doria, near the foot of the Alps; has a population exceeding 5000; is surrounded with a wall, now greatly decayed; and the remains of an amphitheatre, a triumphal arch erected in honour of Augustus Cæsar, and other vestiges of antiquity, give it a venerable aspect. With the rest of Italy, Aoste fell under the dominion of the French during the revolutionary war. It is 50 miles north-west from Turin.

APACTIS, a genus of plants belonging to the Dodecandria class.

APALACHIAN MOUNTAINS, an elevated ridge which begins at the gulph of Mexico, and stretches northward, nearly parallel to the eastern coast of North America. See Alleghany.

APALACHICOLA, a river of North America, which has its source in the Apalachian mountains; forms the boundary, in one part of its course, between Georgia and West Florida, and, in another, between East and West Florida; and having run nearly 400 miles, discharges its waters into the Mexican gulph.

APAMEA, the name of several ancient cities in Asia Minor, one of which was placed in Bithynia, another in Mesopotamia, and another on an island in the river Tigris; but the most celebrated was called Apamea Cibotos, and stood near the confluence of the Orontes and Marsyas.

A medal struck at this city, in the time of Philip the elder, and hence called the *Apamean medal*, has transmitted its name to modern times, on account of the diversity of opinion and controversy which the device and inscription, equally remarkable, have excited among antiquaries. One side of the medal contains the head of the emperor, adorned with a wreath of laurel, and surrounded with the following inscription in Greek capitals: "The Emperor Cæsar Julius Philip Augustus." The reverse represents a square chest floating in water, the lid is open, and a male and female human figure appear in the inside, and two figures seemingly in the act of devotion. A bird, supposed to have some resemblance to a pigeon, sits on the open lid, and another bird, with a small branch of a tree in its claws, appears flying towards the chest. On the side of the chest itself, and under the male figure, the word *Noe*, also in Greek capitals, is inscribed; from which, and from the device, it is conjectured the medal has a reference to the general deluge, and to the name of Noah. But the reader who wishes to investigate this curious subject may consult Bryant's Mythology, Vol. V. which contains a representation of the medal.

APANAGE, or Appenage, is an appellation of that portion of land which is destined by a sovereign for the support of the younger sons of his family, and which returns to the crown on the failure of the male line of that branch to which it was assigned.

APE, the trivial name of a division of the genus *simia*, which includes the whole tribe of apes and monkeys; the first are distinguished by the want of tails, and the second have long tails. See Mammalia.

APELLES, one of the most celebrated painters of antiquity, was a native of the island of Cos, and flourished about the time of Alexander the Great. Numerous anecdotes are recorded of the graphic skill of this ancient artist; but many of them, it is probable, are the invention of his enthusiastic biographers in succeeding ages. Among others, it is said, that an exquisitely finished picture of Alexander and his horse, did not escape the critical remarks of the conqueror of the world; but a real horse being introduced, was so deceived by the painting that he neighed, and drew from the artist an expression of his opinion, that the horse was a better judge than the king.

The picture of Venus rising from the sea, or, as it is usually denominated, *Venus Anadyomene*, which is described as the most splendid production of his pencil, was painted for his countrymen, and carefully preserved in the temple of Æsculapius, in the island of Cos, was obtained from the inhabitants by Augustus, at the price of a hundred talents of tribute, which he remitted, and was transferred to Rome; but the ravages of time had completed the work of destruction on this precious relic in the reign of the emperor Nero, and a copy, or imitation of the original, was executed and substituted in its place.

APENNINES, a ridge of mountains which branches off from the Swiss Alps, sweeps round the gulph of Genoa, advances eastward to the centre of Italy, and then stretching to the south-east and approaching nearer to the Adriatic than the Mediterranean, terminates in the southern extremity of the Neapolitan territory. Monte Velino, near the middle of Italy, and Cimone, farther to the northward, are the highest mountains of this chain; the latter is 6000 feet, and the former exceeds 7800 feet above the level of the sea.

The mineral productions of the Apennines belong partly to the primary and partly to the secondary class of rocks. Granite, gneiss, micaceous schistus, serpentine, and the celebrated Carrara marble, compose the strata in Tuscany and in the districts contiguous to Genoa; and similar rocks with the famous Sienna marble, and some metallic ores, appear in the territory of Sienna; while a grey limestone, in which petrified organic remains are sparingly embedded, is the prevailing rock in that part of the ridge which lies to the southward of Bologna.

APENZEL, a town and canton of Switzerland. See Appenzel.

APEPSIA, from the Greek, and signifying *want of digestion*, is a synonymous expression with *dyspepsia*, or *difficult* digestion, which is more commonly used by medical writers to denote indigestion, or those symptoms which indicate a deranged state of the stomach and other digestive organs.

APERIENTS, or Aperient Medicines, are such as are supposed to produce the effect of removing obstructions in the glandular or vascular systems of the body. See Materia Medica.

APETALOSE, or Apetalous, a botanical term applied to such flowers as have no petals, of which the flowers of the nettle and *carex*, or sedge-grass, are familiar examples.

APHANES, or Parsley Piert, a genus of plants belonging to the Tetrandria class.

APHEK, the name of several cities mentioned in sacred Scripture; as Aphek in the tribe of Judah, near which the Philistines encamped and took the ark which was brought from Shiloh; Aphek in the valley of Jezreel, which was occupied by the Philistines, while Saul and his army were upon the mountains of Gilboa; Aphek belonging to the tribe of Asher, and near the country of the Sidonians; and Aphek, one of the chief cities of Benhadad's kingdom in Syria, near which the battle between Ahab and Benhadad was fought, and the Syrians being routed, retreated precipitately to the city, and 27,000 were destroyed by the walls which fell upon them. Joshua xv. and xix. 1 Sam. xxix. and 1 Kings xx.

APHELION, from two Greek words, signifying *from the sun*, is that part of the orbit of a planet, which is the most distant from the sun, and is opposed to *perihelion*, or that point of the orbit which is nearest to the sun.

APHIS, the Plant-louse, Vine-fretter, or Puceron, a genus of insects belonging to the order Hemiptera, and including numerous species, which latter derive their characteristic appellations from the plants of which they are inhabitants. More than 70 species have been described; and the natural history of the whole tribe has been long a subject of curious investigation. See Entomology.

APHORISM, from the Greek, and signifying to *separate*, a sententious expression, containing a maxim or principle of a science, as, in medicine, the *aphorisms* of Hippocrates, of Boerhaave, &c. and *aphorisms* of civil law, &c.

APHRODISIA, festivals instituted in honour of Venus in different parts of Greece, the most splendid of which were celebrated in the island of Cyprus.

APHRODITA, a genus of marine animals belonging to the class of Vermes, several species of which are natives of the British shores. *Aphrodita aculcata*, or sea-mouse, is remarkable for the beautiful iridescence of the hairy appendages which are the instruments of locomotion, and seem to supply the place of feet.

APHTHÆ, from the Greek, signifying *to inflame*, a disease of the mouth in which small superficial ulcers appear. See MEDICINE.

APHYLLANTHES, Leafless Flower, as the word imports, or blue Montpelier pine, a genus of plants belonging to the Hexandria class.

APHYTEIA, a genus of plants belonging to the Monadelphia class, formed from the only species yet known, *Hydnora*, which is a native of the Cape of Good Hope.

APIARY, a place where bees are kept. For an account of the economy and management of those insects,—see BEE.

APICIUS, seems to have been a general appellation for a glutton, or rather epicure, among the Romans; at least the celebrity of three persons of the same name, who lived at different periods, is recorded. The most famous of this group of epicures lived in the time of Tiberius, and was possessed of immense wealth. In obtaining the choicest, the rarest, and most expensive dishes, among which are enumerated some entirely composed of the tongues of nightingales and peacocks, to gratify the luxury and caprice of a depraved appetite, he expended more than L.800,000 Sterling; and finding that his fortune was diminished, by this wanton expenditure, to L.80,000 Sterling, another depraved feeling seized his mind. The dread of starvation threw him into despair; he swallowed a poisonous draught, and thus miserably terminated an inglorious life.

APIS, the bee, a genus of insects belonging to the order Hymenoptera, and including nearly 300 species, of which more than a hundred are natives of Britain. For the characters and classification, see ENTOMOLOGY; and for the economical history and management of the domestic bee, see BEE.

APIS, the sacred bull of the Egyptians, which was an object of veneration as the representative of Osiris. The bull, from its utility in the labours of the field, was consecrated to Osiris, who was the inventor of husbandry; or, according to the doctrine of transmigration, the soul of Osiris passed into that animal, and hence it became a symbolical deity, and at last a real object of worship.

The mythological history of the sacred bull traces his origin to the influence of lightning, and assigns certain external marks as the real characteristics of his divinity. A white square spot on the forehead, a white crescent on the right side, the figure of an eagle on the back, the rest of the body jet black, and a knot like a beetle under the tongue, were considered the true signs of the animal that was destined to receive divine honours; and when a bull with these indications appeared, the discovery was announced to the people; solemn festivals were instituted at his installation; an annual celebration of seven days was appointed and observed throughout the kingdom; the deified animal was attended by a numerous train of priests; was consulted as an oracle, and the prediction of future events was pronounced favourable or adverse to the person from whom he received or rejected proffered food. Twenty-five years were fixed as the utmost period of his existence; and if he survived that period, he was drowned in the fountain of the priests. His death produced universal despair; but when another divinity was found and announced, grief and lamentation were succeeded by exultation and joy.

The worship of Apis, or the veneration paid to the sacred bull, it has been alleged, with some degree of probability, has some reference to Astronomy; Apis was the tutelar divinity of the new form of the solar year, and the time prescribed for his life corresponds with a period of the sun and moon. In the mythology of this emblematical deity, some allusion is made to a presiding power over the inundation of the Nile, an event on which the fertility of the soil, and the abundance of the fruits of the earth, essentially depend in Egypt. The idolatrous worship of the golden calf, into which the Israelites fell, is supposed to be derived from this Egyptian superstition.

APIUM, or PARSLEY, a genus of plants belonging to the Pentandria class, and to the natural order of umbellated plants.

APLUDA, a genus of plants belonging to the Polygamia class, the species of which are natives of America and the East Indies.

APLYSIA, or LAPLYSIA, a genus of animals belonging to the order Mollusca, under the class Vermes. See HELMINTHOLOGY.

APOCALYPSE, or the REVELATION, one of the sacred books of the New Testament, which is understood to contain predictions concerning future events in the condition of the Christian church. It was written, according to some commentators, about the 96th year of Christ, in the island of Patmos, to which place St John the Evangelist, or the Divine as he is called, was banished by the emperor Domitian. But others assign to it an earlier date, and some ascribe it to a different author. The authenticity of the book of Revelations has not been always acknowledged; and, among others, it was excluded by Luther from the canonical books of sacred Scripture. But it was admitted by the principal fathers of the church in the fourth and fifth centuries, and continues to hold the same place in protestant churches.

APOCOPE, a figure in grammar, by which a letter or syllable is cut off from the end of a word, as *ingenî*, for *ingenii*, *dic* for *dice*.

APOCRYPHA, from the Greek, signifying *concealed* or *obscure*, is the name of such books as are rejected from the canon of Scripture by most churches, because they are of obscure or doubtful authority. It is supposed, that the books to which the denomination *Apocryphal* is now applied, were not considered authentic by the Jews; they are not alluded to by the writers of the New Testament; and they were not admitted into the canonical scriptures of the Christian church in the early period of its history. Some part of the apocryphal books is received by the church of Rome; the church of England recommends them to be read as examples of life and instruction of manners; but they are altogether rejected by the church of Scotland. See Prideaux's *Connections*.

APOCYNUM, or Dogsbane, a genus of plants belonging to the Pentandria class.

APODES, signifying *without feet*, is the first order in the class of fishes according to the Linnæan arrangement, and is thus characterised because the fishes included in it are destitute of ventral fins. See Ichthyology.

APOGEE, signifying *from the earth*, denotes that point in the orbit of a planet which is most distant from the earth.

APOLLINARIAN GAMES were instituted at Rome in honour of Apollo, and were at first celebrated only occasionally, according to the pleasure of the prætor; but about 542 years from the building of the city, a law was passed, appointing an annual celebration on a certain fixed day, which was on the 5th of July. Singing and instrumental music were originally the principal part of the entertainment; but dancing, and other performances, were afterwards introduced, and the spectators were decorated with crowns of laurel.

APOLLINOPOLIS, Great and Small, the ancient name of two celebrated cities in Egypt, now called *Etfou* and *Kous*, which are only miserable villages, exhibiting a melancholy contrast with the magnificent remains of their former splendour, which are still visible. See Denon's *Travels*, vol. iii.

APOLLO, the most celebrated of the heathen deities among the Greeks and Romans. Four divinities of the same name are noticed by Cicero; but the Apollo who is described in mythological history as the son of Jupiter and Latona was the most famous, and always received the most distinguished honours. The name of Apollo is derived, according to one etymology, from the Greek, signifying *the Destroyer*, and according to another *the Deliverer;* but his epithets, expressive of his influence and attributes, are numerous. He is called *Pythius*, either because he slew the serpent Python, or because he is the god of augury; *Pæan*, from the word to strike, because he is the god of archery; *Phœbus*, or the *light of life; Phanæus*, from his splendour; *Delius*, from the island Delos, his birth-place; *Cynthius*, from a mountain in the same island; and *Nomius*, or the Shepherd, from the fertility and enlivening influence which he communicates to the earth.

Divine honours were paid to Apollo as the god of poetry and music, of medicine, augury, and archery. He is represented as a beautiful youth, with a bow and arrows in his right hand, and in his left a harp or lyre; and he is considered a symbolical deity, of whom the sun is the great antitype. Ancient mythology describes him as the son of Jupiter, because that god is the author of the world; his mother was called *Latona*, signifying *hidden*, because before the creation of the sun all things were wrapped up in the darkness of chaos; he is always in the bloom of youth, because the sun grows not old; the bow and arrows imply the piercing solar rays; and the ceremonies of his worship had an obvious reference to the great source of light of which he is the representation.

Youth and beauty
Eternal deck his cheek; from his fair head
Perfumes distil their sweets; and cheerful health,
His duteous handmaid, through the air improv'd,
With lavish hand, diffuses scents ambrosial.
The spearman's arm, by thee, great god! directed,
Sends forth a certain wound. The laurel'd bard,
Inspired by thee, composes verse immortal.
Taught by thy art divine, the sage physician
Eludes the urn, and chains or exiles death.

Prior.

APOLLO BELVIDERE, one of the most celebrated statues of antiquity, shone conspicuous among the noble monuments of art which adorned the halls of the Louvre at Paris, but is now restored to its native soil.

APOLLONIUS, of Perga, a city of Pamphylia, was one of the most distinguished of the ancient mathematicians, flourished about 200 years before the Christian era, and by his profound investigations merited and obtained the noble appellation of the *Great Geometer*. He studied at Alexandria under the disciples of Euclid, and wrote various works on the subjects of his studies; but a Treatise on Conic Sections is the only monument of his genius which time or accident has spared, and of this work, which was composed in eight books, seven have been preserved, four in the original Greek, and three in Arabic translations. A splendid edition of this work was published by Dr Halley at Oxford in 1710.

APOLLYON, or, *the Destroyer*, is mentioned in the book of the Revelations, and corresponds with the Hebrew Abaddon. See Abaddon.

APOLOGUE, a moral fable, or fictitious narrative, which is intended as an agreeable and impressive method of communicating useful instruction. In the parable, the incidents are drawn from what passes in real life among mankind, and the narration must be clothed with probability; but the apologue is not restricted to the rigid rules of probability; the actions of inferior animals, and even of inanimate objects, are introduced. This mode of writing is common in eastern countries; and the fables of Æsop are a familiar example.

APONEUROSIS, a tendinous expansion which stretches over the muscles, and which seems to be intended to facilitate their action; was supposed by the ancient anatomists to be derived from the nerves, and hence the name.

APONO, Peter D', or Abano, a physician and philosopher of the 13th century. See Abano.

APONOGETON, a genus of plants belonging to the Dodecandria class.

APOPHYSIS, an anatomical term for those processes of bones which grow from the bone itself, as the word imports, and are not attached by cartilages.

APOPLEXY, a disease in which the patient is deprived of sensation and voluntary motion. See MEDICINE.

APOSTLE, in its original sense, signifies a messenger sent by another on some particular business, and it is the usual appellation of the twelve disciples, who were commissioned by Jesus Christ to preach the gospel. Twelve apostles were chosen, it is supposed, in allusion to the twelve patriarchs, or to the twelve chief heads, or rulers of the tribes of Israel. The first commission which the apostles received from Christ in the third year of his ministry, limited their labours to the Jewish nation. They were sent out two and two; and in obedience to the command of their Lord, they visited all parts of Palestine, preaching the gospel and working miracles. Their second commission, which was delivered before our Lord's ascension, empowered them to preach the gospel to all nations. Having exercised their ministry for 12 years in Judea, they resolved to disperse to different parts of the world, and determined by lot what country should be assigned to each. According to this arrangement, Peter and John went to Pontus, Galatia, and some other provinces of Lesser Asia; St Andrew to the northern country of Scythia; St Philip to Upper Asia, and some parts of Scythia; St Bartholomew to Arabia; St Matthew to Chaldea, Persia, and Parthia; St Thomas to different parts of India; St James the less remained in Jerusalem, and became bishop of that church; St Simon went to Egypt, Cyrene, Libya, and Mauritania; St Jude to Syria and Mesopotamia; and St Matthias, who was chosen in the room of Judas, to Cappadocia and Colchis. Two apostles, Paul and Barnabas, were added to the original number; and the former is called, by way of eminence, *the Apostle*, and sometimes *the Apostle of the Gentiles*, because, through his ministry, the conversion of the gentile world was chiefly accomplished.

In representations, or paintings, the apostles are distinguished by peculiar badges, or attributes; St Peter is painted with the keys; St Paul with a sword; St Andrew with a cross; St James the greater, with a pilgrim's staff and a gourd bottle; St James the less, with a fuller's pole; St John with a cup, and winged serpent flying from it; St Bartholomew with a knife; St Philip with a long staff, whose upper end is shaped like a cross; St Thomas with a lance; St Matthew with a hatchet; St Matthias with a battle axe; St Simon with a saw; and St Jude with a club.

APOSTROPHE, from the Greek, and signifies *turning away*, is a figure in rhetoric by which those who are absent or dead are addressed as if they were present, and in this way the speaker turns away his discourse from the audience before him. This figure of speech, which is the natural expression of strong emotion, and is chiefly employed by orators and poets, is closely allied to personification, which is also the effect of strong feeling, which addresses itself even to the inanimate objects of nature. The apostrophe was much employed by the celebrated orators of antiquity. The address of Demosthenes to the Greeks who fell in the field of Marathon, is a fine example of this figure. In the oration for Ligarius, the address of Cicero to Tubero is not less splendid, and has been always regarded as one of the most beautiful passages in the works of the Roman orator; and in his oration for Balbus, he thus apostrophizes inanimate nature to bear witness to the virtues of Pompey: "I invoke you, mute regions; you most distant countries; you seas, havens, islands, and shores; For what coast, what land, what place is there, in which the marks of his courage, humanity, wisdom, and prudence are not visible?" Such figures are not unusual in sacred Scripture; thus, "Hear, O heavens! and give ear, O earth! for the Lord hath spoken;" and, "Be astonished, O ye heavens! at this."

APOTHECARY, a person who practises the art of pharmacy, who sells drugs employed in medicine, and prepares them according to the prescriptions of physicians. The apothecaries of London, who constitute one of the city companies, were incorporated by royal charter in the time of James I. by which, and subsequent enactments, they are entitled to certain privileges. They are obliged to make up their medicines according to the directions of the College Dispensatory; and their shops are subjected to visitations by the censors of the Royal College of Physicians, who are empowered to destroy all medicines of a bad quality. Those who wish to trace the history of the establishment of apothecaries in different countries, may consult Beckmann's *History of Inventions*, Vol. II.

APOTHEOSIS, or deification, the ceremony of consecrating heroes and great men after death, observed among the ancients, by which they were enrolled among the gods. Temples and altars were erected to their honour, priests were appointed, and a system of worship was instituted. The form of apotheosis was the following: The body of the deceased for whom this honour was destined was burnt with the usual solemnities; an image of wax, having an exact resemblance, was placed on an ivory couch, where it lay in state for seven days, attended by the senate and ladies of the highest rank, in mourning. The young senators and knights then bore the couch through the Sacred Way to the Old Forum, and afterwards to the Campus Martius, and placed it on an edifice constructed in a pyramidal form. Combustible matters and aromatic substances were strewed around the couch; the knights walked round the pile in solemn procession, and the new emperor set fire to it with a torch; while an eagle with a firebrand, mounting in the air from the summit of the pile, was supposed to carry the soul of the new divinity to heaven.

APPARENT, a term used by astronomers, and expressive of the appearance of the heavenly bodies, as, the apparent distance or magnitude of the sun or planets, in opposition to the real distance or magnitude as they are ascertained by observation and calculation.

APPARENT HEIRS, a term in law, denoting those whose right of inheritance is undoubted and fixed, provided they survive the ancestor or possessor, as the eldest son, or his offspring, who, by the course of common law, are heirs to the father at his decease.

APPARITION, in its general meaning, denotes simply the appearance of an object, but in its more restricted sense it signifies the preternatural appearance of departed spirits. Such preternatural appearances are recorded both in sacred and profane history. Samuel, who was raised by the witch of Endor, is mentioned in the Old Testament; and the appearance of our Saviour, after his crucifixion, to some of his disciples, and of the angel to the apostle Peter in prison, is detailed in the New Testament. The apparition which presented itself twice to Brutus, the first time before he left Asia, and again on the night before the battle of Philippi, is one of the most remarkable examples in ancient history. A similar apparition is noticed by Clarendon, in his history of England; it was the apparition of Sir George Villiers, the father of the duke of Buckingham, which was seen by an officer, and warned him of the assassination of the duke.

Of the preternatural appearances, or apparitions, which are recorded in Scripture History, it has been generally admitted that they ought to be regarded as deviations from the ordinary course of nature, which are permitted for the accomplishment of some useful purpose, or the communication, or confirmation, of some important instruction or essential doctrine. But the existence of other apparitions is usually ascribed to delusions of the imagination, or to lively impressions produced in the mind by those objects which excite deep interest, and strong emotions. In this way the apparition of Sir George Villiers is accounted for. The indignation against the duke of Buckingham had become general, and the dread of assasination had taken strong hold of those whose fortune or expectations were connected with the life of that royal favourite. The officer who saw the apparition was perhaps one of those whose minds were agitated with conflicting passions, in the fear of that event. The father of the duke, who might be supposed, by no great effort of imagination, to be in life, or even his unembodied spirit, could not contemplate with indifference the approaching fate of his son; and, in the perturbation of thought which filled the mind of the officer, he seemed to appear to his alarmed apprehension, to warn him of the impending blow.

APPARITOR, a general appellation applied to all the attendants of the Roman judges and magistrates who were appointed to receive and execute their orders; but in modern times it is restricted to the messenger, or officer, of an ecclesiastical court, or to the beadle of a university, who carries the mace.

APPEAL, a law term, which denotes the removal of a cause from an inferior court to a superior tribunal. In ecclesiastical cases in England, the right of appeal lies from the archdeacon's court to the consistory court of the diocesan bishop, and from this latter to the archbishop of each province, or the court of arches, and, last of all, to the king in chancery, as the head of the church. In civil cases, appeals lie from all the inferior courts in England, as well as from the equity courts of chancery, to the House of Lords. See *Blackstone's Commentaries.*

In matters connected with the church in Scotland, appeals lie from the kirk-session of each parish to the presbytery, from the presbytery to the synod, and, lastly, to the General Assembly, whose judgments are final. In civil causes in Scotland, appeals lie from all the inferior courts to the Court of Session, and from the Court of Session to the House of Lords. Appeals also lie from the inferior courts in Scotland to the circuit, or criminal court of the district, in certain criminal cases, and in civil cases where the subject in question exceeds not twelve pounds sterling. Appeals are brought from the inferior courts to the Court of Session by *advocation*, *reduction*, or *suspension*. See *Appeal*, in *Bell's Dictionary of the Law of Scotland.*

APPEAL, also a term in English law, denotes a criminal prosecution, at the instance of a private individual, to obtain the award of punishment on account of a particular injury, rather than in the view of an offence against the public, and, in this sense, corresponds with the *accusation* of civilians. This mode of prosecution, which seems to have had its origin in those times when compensation was made for offences by the payment of money to the injured person, is still in force, but rarely resorted to; and even at this day, according to the Turkish criminal code, murder is regarded as a private injury, and is prosecuted by the relations of the deceased. See *Blackstone's Commentaries.*

APPELLATION, the name by which any object is distinguished or known. Singular corruptions of names have arisen, from ignorance either of the language from which they are derived, of the manners and customs in which they originated, or the changes to which they have been subjected. Some of these corruptions are not a little ludicrous. The *O yes* of the crier of courts of justice, is a corruption of the French verb *oyez*, *hear ye*, or *listen*; *Beef-eaters*, applied to the yeomen of the royal guard, is derived from *Buffetiers*, because, on great solemnities, they waited at table, or attended at the *buffet*; *Blanc Nez*, or White Headland, has been transformed into *Blackness*; and *L'Aiguille et Fil*, the Needle and Thread, by mis-spelling has been changed into *L'Aigle et Fils*, and being literally translated *Eagle and Child*, has given origin to a common sign.

The capture of the town of Boulogne, in the time of Henry VIII. was a popular event, and gave birth to two signs, which, under various changes, have been transmitted to the present day, but altogether unlike the original prototype. The port, or harbour of Boulogne, was the sign of a well-known inn in Holborn, in London, which was distinguished by the appellation of the *Boulogne Mouth;* but its origin was forgotten, and, from the corruption of the name, a new edition of the sign appeared, and exhibited a *bull* and a gaping *human mouth*, and, under the title of the *Bull and Mouth*, is recognised at this day. The sign of the *Bull and Gate* acknowledges a similar origin. The gates of Boulogne at the same time being transported from France, and deposited at Hardes in Kent, as a monument of the victory, became also a popular sign, under the appellation of *Boulogne gate*, which was afterwards converted into the *Bull and Gate*. The sign of the *Bell and Savage*, or, as it is familiarly called, *Bell Savage Inn*, is supposed to be derived from *La Bell Sauvage*, the beautiful savage, alluding to a female found in the woods in France, or from Lady Arabella Savage, to whom the property originally belonged. The sign representing a *bell* and *a wild man*, is conjectured to have been intended as a rebus for her name.

APPELLATIVE NAMES, are such as are applied to a class of objects, as *city*, *river*, *man*, *bird*, in opposition to proper names, which are limited to a single object.

APPENRADE, or ABENRADE, a town of the duchy of Sleswick, in South Jutland, in Denmark, stands on a bay of the Baltic, and is four miles distant from Flensbourg; the surrounding hills protect the harbour, which is commodious, from storms; the trade is considerable, and ship-building is extensive; its commercial prosperity has greatly increased the number of the inhabitants.

APPENZEL, a canton of Switzerland, about thirty miles in length and twenty miles in breadth, is a mountainous district, but affords good pasture, and yields some grain and fruits. The population exceeds 50,000, of whom 13,000 are Roman catholics. Some linen, crape, fustian, and thread are manufactured.

APPENZEL, a town of Switzerland, and capital of the canton of the same name, stands on the banks of the river Chus, is forty miles east from Zurich, and in N. Lat. 47° 17'. and E. Long. 9° 31'.

APPETITE, in its general signification, is the desire or inclination which is supposed to be conducive to our happiness. Writers on morals have divided appetites into sensitive and rational. Under the first are included those which proceed from the impulse of the senses, or from a blind propensity to a certain object, and are not subjected to the influence of reason; but the rational appetites originate from reflection on the intrinsic value of the object, and thus are under the guidance of reason. The word appetite is properly limited in its application by Dr Reid to that class of desires which are accompanied with an uneasy sensation, and which are strong or weak in proportion to the desire of their proper objects, which are not constant, but, being sated by their objects for a time, return after certain periods. Of such desires, or appetites, hunger and thirst are examples.

APPIAN, an eminent Roman historian, who was a native of Alexandria, flourished about the beginning of the second century, in the time of Adrian, Trajan, and Antoninus Pius, and became celebrated as a pleader at Rome. His History of the Roman Empire is composed in the Greek language, and is included in twenty-four books, fragments of some of which only are extant; but the narrative is generally regarded as authentic, the stile is simple, and the work displays great knowledge of military affairs.

APPLAUSE denotes the approbation of an audience at a public spectacle, which is expressed by the clapping of the hands. See ACCLAMATION.

APPLEBY, the county town of Westmoreland, in England, stands on the banks of the river Eden, was a Roman station, and at one period of its history enjoyed great privileges and prosperity. It is now chiefly distinguished by an abundant corn market. The population scarcely exceeds 800, and it is 29 miles distant from Carlisle.

APPOGIATURA, from a word which signifies to lean upon, is a small additional note introduced between two other notes, for the purpose of embellishment in musical compositions.

APPRENTICE, from the French word which signifies *to learn*, denotes a person who is engaged to serve a master for a fixed period, for the purpose of being instructed in some art or profession. Various regulations, with regard to the obligations under which masters and apprentices bind themselves, and with regard to the privileges and immunities which belong to those who have served a legal apprenticeship, have been enacted by the legislature from the time of Queen Elizabeth down to the present day.

APPRENTICESHIP, the period of service during which an apprentice, by the contract he has entered into, is bound to remain with a master, for the purpose of learning an art or profession. The nature and mutual obligations of engagements of this kind, hold a conspicuous place in the modern code; but as such contracts are passed over in silence in the Roman law, and even no word in Greek or Latin expressive of such a connexion, it is supposed that they were unknown in ancient times. Is it not probable that those arts and trades for which apprenticeships are thought necessary in modern times, were exercised by slaves among the Greeks and Romans, and in this way were overlooked in their political regulations?

The duration of apprenticeships is different in different towns and trades in France. In many trades five years is the usual term in Paris. The act of the legislature passed in the fifth year of Queen Elizabeth's reign, and called the *Statute of Apprenticeships*, fixes the period at seven years; and this became the public law in all arts and trades practised in market towns; but its operation is understood to be limited to those trades which existed when the enactment was made. No general law has prevailed in Scotland to regulate the term of apprenticeship. The period is therefore different in different corporations, and rarely exceeds three or five years. The restrictions relative to apprenticeships in Ireland are similar to those of England; but by a regulation of the Irish government, which was ratified by a legislative enactment in the reign of Charles II., foreigners and aliens are admitted freemen in any city or corporation, on payment of the small fine of twenty shillings to the municipal authorities.

The necessity and inconveniences of apprenticeships have been a subject of controversy among writers on political economy. Apprenticeships are necessary, it is alleged, to give sufficient time to those who are to be employed in any art or trade to acquire habits of industry, and at the same time to insure to the public perfect workmanship in the productions of any trade or manufacture. But, on the other hand, it is maintained, that the apprentice receiving no wages is a loser, and the master a gainer by the fruits of his labour, in a very disproportionate degree; and the loss sustained by the one and the gain of the other, increase in proportion to the length of the period of service. It is supposed also that apprenticeships are injurious to the public, by excluding competition, and thus preventing the productions of art from being brought to market at the lowest possible price. But the evils which arise from corporation laws, when rightly investigated, may perhaps appear to be more imaginary than real; the expedients resorted to for relief often obviate their effects; and in England the more oppressive restrictions were removed, in 1813, by a repeal of parts of the statute of Elizabeth.

APPRISING, an action in the law practice of Scotland, by which a creditor attached the estate or property of a debtor for payment of a debt, which property was redeemable by the debtor within a prescribed period. This form of diligence is now disused, and the mode by adjudication substituted in its place.

APPROACHES, a term used in fortification, to denote the works which are thrown up by besiegers to enable them to approach nearer a fortress without being exposed to the guns of the enemy.

APPROACHING, a method of engrafting a shoot of one tree on a branch of another, without removing it from the parent stem till the union be completed.

APPROBATION, a term used by writers on morals, and expressive of the satisfaction which is felt in the contemplation of certain actions. The principle of approbation is ascribed by some to the feeling of self-interest, and by others to motives of pure benevolence, altogether independent of private happiness.

APPROPRIATION, a term in English law, which denotes the separation of a benefice, and its perpetual annexation to some religious corporation. When the parochial clergy were first instituted, the tythes were divided into four parts; one part was destined for the bishop, one for defraying the expence of repairs of the church, a third for the poor, and a fourth as a provision for the incumbent. When the bishops were otherwise provided for, they were excluded from their share of the tythes, which were then distributed into three parts only. The monasteries devoted a small portion to the support of the officiating priest, and reserved the remainder to the pious uses of their own institutions. All the advowsons within their reach were obtained by gift or purchase, and the benefices were appropriated to their own corporations. To complete such appropriation, the king's licence in chancery must be obtained, and the consent of the patron and incumbent when the church is full, and of the diocesan and patron when the benefice is void. See *Blackstone's Commentaries.*

APPROXIMATION, a term in arithmetic and algebra, which denotes the nearer and nearer approach to a root or other quantity sought, without finding it exactly.

APPULSE, denotes the approach of a planet to a conjunction with the sun or a star. Some astronomers employ this term to express the apparent contact of the two bodies; and by others it is considered synonimous with *occultation*, when one of the bodies is completely obscured by the other.

APRIL, derived from the word *aperio*, "to open," is the fourth month of the year, according to the common computation; and is thus denominated from the opening or expansion of the buds, or, in a more extended signification, because the earth in this season opens her bosom for the production of vegetables.

APSIS, a term in astronomy, denoting the two points of a planet's orbit, when it is at the greatest and least distance from the sun or earth. The line connecting these points is called the *line of the apsides*. The *higher* apsis is the point nearest the sun or earth, and corresponds with perihelion or perigee; and the *lower* apsis, which is analagous to aphelion, or apogee, is the point most distant from the sun or earth.

APTERA, from the Greek, and signifying *without wings*, is the seventh order in the Linnæan classification of insects, and, as the name imports, includes those insects which are destitute of wings. See Entomology.

APULEIUS LUCIUS, a Roman philosopher, who professed to be a disciple of the Platonic sect, but is chiefly celebrated as the author of a singular romance under the title of the *Golden Ass*, was a native of a Roman colony in Africa; flourished in the second century under the Antonines; studied at Carthage, Athens, and Rome, and in a short time became so perfect in the Latin language that he acquired great reputation as a public pleader. He was charged with using magical incantations in obtaining a rich widow in marriage; and it is supposed that the accusation may have originated either in his own belief in the art of magic, or from the remarkable adventures detailed in the Golden Ass, many of which are accomplished by means of that occult science; but it is more probable that it arose from the prevailing notions of the times. In the work alluded to, which is considered as the original of all succeeding romances, the author is introduced ingratiating himself into the confidence of the female servant of a sorceress, from whom he acquires the secrets of the art of her mistress. Anxious to possess the means of extending his knowledge, he expressed a wish to be transformed into a bird; but the wrong ointment being applied, effected his transformation into the form of an *ass;* in this form he is seized by robbers, loaded with their booty, and conducted to a cave, the scenery of which, the inhabitants, and the incidents that occurred during his residence in it, have a near resemblance to the description of the cave of the robbers in the celebrated Gil Blas of Le Sage; and having encountered many other adventures, he is at last restored to his own proper form.

APYROUS, a term which is equivalent with incombustible, is applied to those substances which remain unchanged in the strongest heat.

AQUA FORTIS, or the common nitric acid of the shops, in that degree of dilution which is necessary for many purposes in the arts.

AQUA REGIA, a compound of nitric and muriatic acids, was so denominated by the alchemists and older chemists, because it dissolves gold, the *king* of the metals. See Chemistry.

AQUA TOFANA, a poisonous liquid, which is said to have been extensively employed at Naples and Rome during the latter half of the 17th century, and has been the subject of some very learned dissertations to prove its existence and effects. Six hundred persons, according to the pretended confession of the inventress, Tofania, are said to have fallen victims to this secret poison. But the whole story forms such a tissue of improbabilities, absurdities, and contradictions, that a sober enquirer would be almost disposed to doubt the whole. Of the infamous Tofania herself, it is said, that "the little that we know of her rests upon the authority of travellers, and is evidently exaggerated, and sometimes irreconcileable with established facts." One traveller asserts, that Tofania was dragged from a sanctuary by the civil power, and after being strangled, her body was thrown at night into the court of the convent, for the purpose of suppressing the indignation of the clergy on account of the violation of the sanctuary. But at the distance of 15 and 20 years, two other travellers declare that she was alive and in prison. It is stated by one author, who visited Naples in 1780, that this poisonous liquor was still in use, while another regards it as an unfounded calumny.

The nature and effects of this liquid exhibit the most extraordinary part of its improbable history. It is described "as being as limpid as rock-water, and without taste;" and there was not a lady in Naples who had not some of it lying openly on her toilette among her perfumes. "It was generally believed that the effect of this poison was certain death;" and that it could be so managed as to prove fatal in any determinate time, from a few days to a year or upwards. Four or six drops were reckoned a sufficient dose, and they were said to produce no violent symptoms, or but very seldom; no pains, convulsions, inflammation, or fever, but only a feeling of indisposition, without any very definite symptoms, except, sometimes, inextinguishable thirst. The victim, however, sunk into a languid state; and with disgust at food, and weariness of life, death closed the scene. It was at last discovered, that lemon-juice, early and copiously administered, was sometimes a certain antidote, and brought the poison into disrepute.

That crimes of so deep a dye exist among a dissolute and licentious people, as well as among nations more distinguished by morality and humanity, can scarcely be doubted; but that they prevailed to such extent, and were perpetrated by means of a liquid "as limpid as rock-water, and without taste," and with a few drops of this liquid, which had no perceptible effects on the unfortunate victims, and could be so managed as to produce certain death at the end of a few days, or at the end of twelvemonths, exceeds all power of belief. The whole story must either be regarded as a mere fiction, invented for the amusement of the credulous, or it may be traced to an aberration of the mental faculties, somewhat akin to the notion of witchcraft, which had taken a strong hold of the minds of the inhabitants of the northern part of this kingdom about the same period, and spread so rapidly in New England as to threaten the depopulation of that infant colony. See Beckmann's *History of Inventions*, and *Aqua Tofana in Supplement to Encyclopædia Britannica*.

AQUA VITÆ, or water of life, spirits obtained from vegetable productions by means of fermentation and distillation. The spirits from the fermented juice of the grape are well known by the name of *brandy*, and from grain by the denomination of *whisky*, in Scotland. To the latter production the term *aqua vitæ* is restricted by some.

AQUÆ, along with some descriptive appellation, is applied to many places which were formerly under the dominion of the ancient Romans, and were usually places of resort on account of mineral waters; as *Aquæ Calidæ*, from its hot springs, now Bath, in England; *Aquæ Calidæ*, for the same reason, now Orense, in Spain; and *Aquæ Sextiæ*, a colony founded by Sextius Calvinus, contiguous to a spot abounding in cold and hot springs, and now Aix in France.

AQUÆDUCT, an artificial structure for conveying water over an unequal surface. Unacquainted with the hydraulic principle of water that is conveyed in pipes to whatever depth they are laid below the level always rising to the height of its source, the ancients supplied their cities with that necessary fluid, by conducting it nearly on a level, or at least with a gentle slope to produce a current towards the place of discharge; and when the inequality of surface over which the water was to be carried, did not admit of such a conveyance, an artificial course was formed, by perforating mountains, and raising ranges of arches in vallies. The stupendous works of the Romans, which were constructed for this purpose in different parts of their extensive empire, still excite, in their magnificent and mouldering remains, the wonder and admiration of succeeding ages. The arches were constructed of stone or brick, and when the valley was deep, several ranges of arches, one above another, were formed. Some of the arcades of a Roman aquæduct, which conveyed a large body of water across the Moselle, are still visible near Metz; and 159 arches composed of massy stones, joined without mortar, yet exist a striking monument of Roman grandeur at Segovia in Spain. In this aquæduct a double range of arches raised the water to more than 100 feet.

The most splendid aquæduct of modern times was constructed by Louis the XIV. of France, for conveying the waters of a river to Versailles. It consists of 242 arches arranged in three rows, and the length of the course is 7000 fathoms. In Britain such structures are usually destined for conveying the waters of canals across vallies. A magnificent aquæduct carries the Ellesmere canal over the vale of Llangollen in North Wales; and the vale of the Kelvin five miles from Glasgow is traversed by an aquæduct on a smaller scale for continuing the course of the Forth and Clyde canal.

AQUAMBOE, or AKAMBO, a kingdom on the coast of Guinea, in Africa, which occupies only about 20 miles of the coast, but extends more than 100 miles inland. The natives are described as a warlike race, divided into tribes, which are subject to the king of Aquamboe, whose authority is stated to be highly tyrannical and oppressive. With a soil generally fertile, the produce of their agricultural labours secures them not always from a scarcity, and their trade is of no great account.

AQUARIUS, or the water-carrier, is the eleventh sign of the zodiac, through which the sun moves in the month of January.

AQUARTIA, a genus of plants belonging to the Tetrandria class.

AQUATINTA, a method of engraving on copper, from which soft and beautiful impressions, resembling drawings with Indian ink, are obtained. See ENGRAVING.

AQUILA, a constellation of the northern hemisphere which is generally united with Antinsus, and includes, according to the Britannic catalogue, 71 stars.

AQUILA, a town of Naples, and capital of farther Abruzzo, contains 10,000 inhabitants. The culture of saffron in the neighbourhood was formerly extensive. This town suffered a dreadful calamity from an earthquake in February 1703. On the first shock the inhabitants fled from the city, but returned to vespers in the evening, when the shocks were repeated, and 24,000 persons were buried in the ruins, 1500 were wounded, and a church with 800 persons, who had fled to it for shelter, was swallowed up. Aquila is 30 miles distant from the sea.

AQUILEGIA, or COLUMBINE, a genus of plants belonging to the Polyandria class.

AQUILEIA, once a flourishing and populous city of Italy, has now dwindled to a small village. It stands at the entrance of the gulf of Trieste. In the fifth century it resisted a siege of three months, but at last was forced to yield to the victorious arms of Attila king of the Huns.

AQUINAS, THOMAS, a scholastic divine of the 13th century was born at Aquino, in Italy, from which he derives his name, in 1224, and died in 1274, is greatly celebrated for his profound studies and voluminous writings, to which high authority is attached in the Roman Catholic church. He was canonized in 1323, by the Pope; and, in the 16th century, Pius V. distinguished him by the honourable appellation of the fifth doctor of the church.

AQUITANIA, an ancient province of Transalpine Gaul, which was conquered by Cæsar and his lieutenants, was, after various revolutions, erected into a kingdom by Charlemagne, in the 8th century, but was reduced to the rank of a dukedom by Charles the Bald. The wealth and effeminate manners of the Aquitani rendered them an easy prey to the warlike Romans. Guienne and Gascony are supposed to include this province.

ARABESQUE, or MORESQUE, a style of ornamental painting and sculpture, which was practised by the Arabs and Moors, for the decoration of their apartments; the origin of which, it is said, is derived from the prohibition of the use of images of men or other animals, by the Mahometan religion. Imaginary plants, stems, and foliage, are substituted in their place.

ARABIA, a large country in Asia, is distinctly bounded by the Red sea on the west, the Indian ocean on the south, the Persian gulf and the Euphrates, or more correctly speaking, the deserts towards the west of that river, on the east; while the northern limit, which is much less obvious, may be said to be determined by Palestine and Syria, or the bleak and almost uninhabitable country which extends from the isthmus of Suez to Palmyra, and the same river, forming part of the modern Pachalic of Damascus. Its length, from Cape Babelmandel, at the entrance of the Red sea, to the north-east extremity on the Euphrates, is estimated at from 1500 to 1800 British miles, and its breadth, in the direction of the tropic of Cancer, at about 800; so that, in general terms, this country may be conceived to be nearly four times larger than the kingdom of France, according to its ancient and restricted dimensions.

Divisions.—This extensive region, from the time of Ptolemy the geographer, has been divided into three unequal portions, the names of which, though not recognized by the natives, are very characteristic of some striking peculiarities. Thus, Arabia Petræa, or the Stoney, designates a small country in the north-west corner, adjoining the Red sea, Egypt, and Palestine, remarkable for the abundance of rocks and hills; Arabia Deserta is the significant term appropriated to an immense sandy plain, occupying most of the central and eastern regions; and the enviable title of Arabia Felix, or the Happy, is, comparatively speaking, merited by the beautiful and on the whole fertile lands in the south-west quarter, on the shores of the Red sea and Indian ocean. But other distinctions, established in the course of political revolutions, and become familiar to Europeans in the progress of geographical discovery, require to be specified. Of these the following are the most noted: Yemen, an interesting and much celebrated province in the south-west angle, described by Sir William Jones, in his Essay on Asiatic Poetry, as a kind of paradise, not more gratifying to the senses than calculated to excite the energies of creative imagination; Hedjas or Hejas, a district stretching on the coast of the Red sea, to the north of Yemen, and presenting some of the objects and places most memorable in the page of Arabian history; Hadramaut, a large province lying on the south coast, eastward of Yemen; Schadschar, or Seger, and Mahrah, two tracts partly sea-coast and partly inland, still farther to the east; Oman, a detached and hilly province, which forms the eastern corner of Arabia, at the mouth of the Persian gulf; Lachsa or Bahrein, as it is sometimes called, situate on the western border of that gulf, and of course opposite to the kingdom of Persia; and Neged or Nedsjed, a very large inland country, comprising the two districts of Ared and Kerge, and extending across the peninsula so as to occupy most of the central regions. All of these provinces, or states, as they may be called, from the circumstance of separate and tolerably independent governments, are subdivided into smaller districts.

Appearance.—Arabia has been variously described —as bearing a strong resemblance to Africa in its larger features—as a group of mountains encircled by an immense belt of sandy deserts—or as a vast, flat, and unprofitable plain, skirted by fertile elevations, and sparingly studded with verdant patches. The accounts on the whole concur as to its general unproductiveness and gloom, and its partial exuberance and splendour, but differ somewhat in the allotment of those extraordinary discordancies. We may safely hazard the assertion, that with some few exceptions, chiefly on the shores of the seas by which it is enclosed, Arabia is a dreary arid waste, scarcely fitted for animal habitation, and almost utterly precluding the visits of travellers, by the fervour of the tropical rays to which it is exposed, and the want of those common blessings which are essential to the support of life. Some stinted herbage, and other feeble indications of moisture, occasionally, and at terrific distances, tantalize rather than gratify desire; but wood, water, and fruit, are hardly to be met with in many days journey; the air itself, which in other countries affords so salubrious a refreshment, is often, by its heat and noxiousness, the swift messenger of death; and even the earth, or rather the sand which supplies its place in this region of calamities, not unfrequently joins in the alliance against the presumptuous passenger, rising up into waves more dangerous and scarcely less lofty than those of the ocean, and threatening every moment to obliterate every token of his existence. By some of these means, particularly the last mentioned, whole caravans and armies have perished, without leaving a single memorial of the catastrophe.

Climate, &c.—The characteristics of the climate, it will easily be understood, are heat and drought. But there are some exceptions, especially in the hilly part of Yemen and on the borders of the Indian ocean. In the former, a regular rainy season prevails from the middle of July to the end of September; though even in that country, it is said, the sky is seldom obscured for an entire day, and in some of the plains a whole year passes without a shower of rain. The rainy season occurs earlier in Oman. A few hills scattered throughout the internal districts occasionally attract vapour from the atmosphere, which descends in small showers scarcely sufficient to prolong feeble vegetation among the thirsty sands, or is collected into small pools, the possession of which is eagerly and sometimes fatally contended for by the no less needy inhabitants and travellers. In Yemen, where the finest climate is enjoyed, and where the highlands are most distinguished by their fertility and agreeableness, the thermometer frequently and for long periods rises above 90°; but the average temperature of Arabia does not exceed 80° throughout the year.

Soil, &c.—The soil is generally thin and poor. But some crops thrive in different places with remarkable luxuriance. Grain of various kinds, as maize, millet, and wheat, are cultivated, but yield only sparing returns, in consequence, probably, of the very unskilful management adopted. Beans and barley are more plentiful. Rice and oats are almost quite unknown. Culinary vegetables, a variety of fruits, coffee, and sugar, abound in some favoured districts; certain provinces in the south have been long celebrated for aromatics and spiceries; and even the dismal monotony of the desart is now and then interrupted by the friendly palm-tree and the generous vine. Arabia is destitute of forests; but clusters, or groves of trees, are to be seen on some of its mountains, especially towards the west and south-west coasts. The botany is scanty and rather uninteresting. Among the larger productions in this department of natural history, may be enumerated several species of palm-tree, the orange, fig, apricot, and almond, all of which are considered indigenous; the tamarind, pomegranate, and cotton tree, supposed to have been introduced from Persia or India; to which may be added a great variety of melons and gourds, *mimosa nilotica*, which yields the gum Arabic of the shops, and the *amyris opobalsamum*, from which is obtained the costly gum of Mecca; and among the shrubs and herbaceous plants we distinguish the *ricinus* or *palma-christi*, the seeds of which afford by expression the valuable substance generally denominated castor oil, the senna, and liquorice, all three used in medicine.

Zoology.—The first place in the zoology of Arabia is due to the horse, of which it is considered by some naturalists the original country, though others refer it to Independent Tartary. The breed is small in size, but full of spirit, admirable for activity, and possessed of the noblest generosity of temper. Perhaps, indeed, the genuine Arabian steed is the most compact piece of powerful and efficient mechanism in the brute creation. The natives, who are justly sensible of their value, pay the utmost attention to their genealogy and education, carefully witnessing and registering the former, which is said, in some cases, to be several centuries old, and spending a great portion of their time on the latter. Next to the horse, in point of rank, and superior in certain important qualities, is the camel. This extraordinary animal appears to be a native both of Arabia and Africa; to the peculiarities of both of which countries it is very obviously accommodated. Its eastern title, *the Ship of the desert*, is well merited by a variety of excellencies, which fit it, almost exclusively of all the rest of the carrying race, for passing a desolate and unstable ocean of sand. The species found in Arabia, according to Niebuhr, is that with only one hunch on its back, commonly denominated the dromedary. This is said to be much lighter, and to have far more speed than the other sort with two hunches, which seems to prevail most in the Crimea and Tartary. In the list of quadrupeds are mentioned the hyena, jackal or chacal, panther, wild boar, wolf, fox, monkey, and jerboa. Eagles, vultures, the ostrich, and pheasant, are met with. Land-tortoises and locusts are sometimes used as food. The variety of the serpent kind is considerable; and some of them, particularly a very slender species, called *beatan*, give a bite that is said to prove speedily fatal.

Mineralogy has not hitherto received much acquisition from this country. The precious metals are no where found in it, with the exception of a small portion of silver in the lead mines of Oman; and of the richer gems, it is not certain that any are to be met with which have not been brought from India in the course of commerce. The onyx-stone has been discovered in Yemen; a kind of agate, called Mocha stone, comes from the place so named, near the strait of Babelmandel; alabaster, selenite, basalt, and various sorts of spars, are enumerated by Niebuhr among its more common productions. The mountains in general, it is believed, are of the *primitive* order; and the ever-memorable Mount Sinai, in particular, is said to exhibit two striking summits of red-coloured granite.

Population.—The Arabs are an original and a very ancient people. They boast of a descent from Ishmael, the son of Abraham, by his concubine Ha-

Arabia.

gar; and perhaps have undergone fewer changes of feature or character than any of the eastern nations, all of whom are so much noted for permanency of manners and customs. Some circumstances render it probable, that the southern provinces were peopled even earlier than Abraham's time, by a branch from the same stock, whence the Assyrians had their origin. But the distinction, though sometimes kept up by prejudice and animosity amongst the natives themselves, vanishes from the view of the philosopher, who sees only one characteristic generation, merely modified, like the casts of India, by peculiarities in their occupations and modes of life. Of this kind it is necessary to mention the threefold classification, into Bedouines or Bedoweens, Mædi or Moædan, and Fellahs. The first, in whom the national peculiarities are most strongly marked, maintain an irregular and desultory residence in the desert, living under tents, and rarely visiting any of the towns, which are mostly situate on the coast. They are remarkable for activity and the love of independence. The Mædi are shepherds, whose employment requires and produces greater steadiness of character and longer continuance in one place. The last class includes the agriculturists, who are, of course, still more restricted to a fixed abode, and are confined indeed to few and very distant portions of the country. The inhabitants of the cities are understood to have suffered material changes in the progress of time through the influence of political events, and differ considerably therefore from those of the country. It does not appear that the population is any way proportioned to the vast magnitude of this region, which is readily explained by what has already been mentioned; but of its amount no satisfactory estimate, and scarcely, indeed, a plausible conjecture, has been offered.

Government.—Arabia is divided among a number of chiefs, having different titles and powers, almost entirely independent of each other, but occasionally acknowledging one nominal head, and sometimes really united for one common purpose. The principle of government which prevails is that of a father over his family. His power is almost unlimited, and it is generally hereditary. But the chiefs of the tribes, who are usually denominated Sheiks, or Schiecks, have been sometimes deposed for their tyranical conduct; and those sheiks who have associated under a common chief, exercise the right of appointing his successor, who is generally chosen, indeed, out of the same family, but not without due regard being paid to superiority of talents for the office. This privilege, and the power of deposition, render condescension and mildness of behaviour very requisite on the part of the grand sheik. The sheiks possess no fiefs, as in the feudal governments, but have a kind of property in the persons of their subjects. They lead the armies, administer justice, either directly or by deputy, and decree peace and war, but seldom without taking the advice of competent persons in the tribe. The structure of the genuine Arab government is altogether remarkable for simplicity and force. But in modern times, and chiefly through the agency of a religion highly favourable to despotism, if not refinement of policy, various distinctions and institutions, formerly unknown, have taken place, and they prevail most in those parts of the country where civilization has made the greatest progress. Under such an influence, unequivocal resemblances to the monarchial establishments of other Asiatic countries appear. The title of *imam*, which implies vicar, that is of Mahomet, is, properly speaking, ecclesiastic, but is often applied to chiefs of superior dignity, and becomes synonymous in some instances with the better known name of *caliph*. It is therefore given to the sovereigns of several provinces, and appears to entail a greater degree of authority and consequence than is possessed by the sheiks. An imam, in fact, is the head of a country, rather acquired by conquest, than voluntarily associated under him, having various tributaries, who are sometimes the sheiks themselves, and possessing the almost entire and unrestricted administration of civil, ecclesiastical, and military affairs, which, however, he finds it convenient to allot to subordinate and responsible officers. But though absolute, generally speaking, it seems, according to Niebuhr's information, with respect to Yemen at least, that his authority over life, if not some other important concerns, is liable to check from a tribunal of which he is merely the president, and before which all capital cases must be decided. This restraint is probably more nominal than real, and is rarely exercised: Such is the inference to be drawn from the circumstances of the imam appointing the assessors of this tribunal, and his having the power of removing them at pleasure. We are told, indeed, that these sovereigns have never found their advantage in violent measures, and that acts of tyranny have commonly ended in the destruction of the agents. This may be true; but the very fact itself proves the influence now suggested, though the testimony of experience condemn its exercise.

Ranks, &c.—There are many public officers, but few titles of honour in the court of the imam. His first minister is styled *fakih*. This term is somewhat equivalent to our *gentleman*, and can scarcely be thought, therefore, to denote uncommon dignity. The titles of *wali*, *dola*, and *emir* are given to the subordinate governors of districts, but this last name is not unusually considered of equal import with *imam*. *Sherriffe* is the denomination of certain descendants of Mahomet, who posses sovereign power in some cities of Hedjas. *Mufti* and *cadi* signify persons engaged in the ecclesiastic and civil judicatures. But the prince himself is usually the high priest, as well as the supreme judge.

Religion.—Arabia is the birth-place of Mahomet, and the country in which he first established his doctrines. The Koran is universally received as the standard of faith; but according to the prediction of that singular man, and as might, indeed, have been expected, from the caprices as well as the improvement of human nature, it has given rise to a variety of sects, who are exceedingly hostile to each other. In general, it has been said, they are more remarkable for credulity than purity of morals. Of late years, a sect differing essentially from all other believers, and called after Waheb their founder, has made astonishing progress in overturning both the religious opinions and the political establishments of this country.

Commerce, &c.—Previously to the discovery of the course to India by the Cape of Good Hope, the commerce of Arabia was very extensive. Since that period it has rapidly declined. The exports, which are chiefly from Yemen, consist of aloes, myrrh, senna, and a few other drugs, frankincense, and coffee. The Arabs import the useful metals, either in mass, or wrought into various implements and utensils, glass, colouring substances, certain kinds of cotton goods, and different luxuries. These imports are rarely from Europe direct, but are supplied from the European settlements on the coast of India. Africa furnishes Arabia with ivory, gold, and slaves. The few manufactories carried on in this country are generally in the hands of strangers, who reside in the cities and towns on the coast, especially that of the Red sea. But the natives appear to be endowed with every intellectual faculty requisite for their perfection, and to need only to be encouraged to excel.

Cities, &c.—Arabia cannot boast much of its cities. Mecca is the most famous; but being sacred among the believers of Mahomet, and in consequence inaccessible to the people of any other religion, it has seldom or ever been described in a satisfactory manner. It is situate a full day's journey from Jidda, or Jeddo, a port nearly about the centre of the eastern shore of the Red sea. The buildings, which are mostly of stone, are said to be better than those in any other city in Arabia. Excessive heat prevails in it during the summer months. The inhabitants are wont to shut their windows to avoid it. They water their streets also, in order to moderate the temperature. But it is not unusual for persons to be suffocated by the burning wind called *Samoum*, or *Samiel*, if accidentally exposed to it. Of the size and populousness of this city, no correct information has been obtained. The principal edifice, from which it derives its importance in the minds of the orientals, is the Kaba, or Caaba, i. e. House of God, in which is deposited the most precious object of Mahommeddan superstition. This is a black stone, said to have been brought by the angel Gabriel from heaven. It was at first, according to report, of a bright white colour, so as to dazzle the eyes of the beholder; but being of a compassionate nature, and having wept long for the sins of mankind, it gradually lost its complexion and clearness, and at last assumed its present hue and opacity! In point of architecture, the Caaba is an awkward, clumsy building, totally unworthy of notice. There is decisive reason to believe, that, even earlier than the days of Mahomet, this city was highly venerated by his countrymen, and that he merely availed himself of the current opinion to enhance its importance. The governor of Mecca, previous to the time of Waheb, was a temporal prince, whose revenue was augmented by gifts from the various sovereigns professing the same faith. Medina, to the north of Mecca, at the distance of about 200 miles, and like it about a day's journey from the coast of the Red sea, is but a small place, without any thing remarkable, except the tomb of Mahomet, which is erected in a mosque, and is of plain mason-work, in the form of a chest, inclosed within iron rails, for the obvious purpose of keeping the populace at a distance, who are said to have been in the habit of throwing dirt upon the tomb, which they afterwards scraped off, and preserved as a relic. In this circumstance, we apprehend, may be seen the origin of the absurd report so prevalent amongst the Mahometans, that the coffin of their prophet is suspended in the air by means of magnets. Pilgrims usually visit the tomb, but this is not essential to any religious exercise. It is placed between two tombs, in which are deposited the remains of the two first caliphs, and is not more magnificent than those of the founders of most other mosques. The building which covers it is decorated with a piece of embroidered silk, and was commonly guarded by forty eunuchs, for the security of the precious stones and other treasure occasionally offered to it by wealthy Mussulmans.

Sana or Saana, at the bottom of a mountain called Nikkum, in the south-west part of Yemen, is a large town, reputed indeed the chief in Arabia. It is about four miles in circuit, but much of the space is occupied by gardens. The houses are mostly built of bricks dried in the sun, fuel being very scarce. The walls are of the same material, and have seven gates, and there are several palaces, some of which are of stone. It is a place of some trade. Some small streams fertilize the neighbouring country, which is noted for its beauty and rich fruits. The palace of the governor, or prince, which is at a little distance from the town, is denominated "the castle of delights," a phrase very agreeable to an eastern imagination.

The town of Mokka, Mocho, or Mocha, which lies near the entrance of the Red sea, is an indifferently built place, containing about 10,000 inhabitants, who are chiefly occupied in trade, and possessing a convenient harbour for small vessels. The coffee which comes from this town, and which constitutes its prime commodity, is in the highest esteem throughout the world. Our countrymen have of late years almost entirely engrossed the trade of this thriving place.

Jidda, or Jeddo, the sea-port of Mecca, is small, situate in an unhealthy barren tract, badly supplied with water.

The province of Hadramaut, according to the scanty intelligence which Niebuhr collected, appears to contain an immense number of towns and villages. Of those he has mentioned, the following may be considered most important. Schibam, about eight days journey from Sana, the seat of a powerful prince, and perhaps the Saba of the ancients; Keshim, a sea-port, visited by the English; Dafar, or Dofar, a sea-port, near Cape Morbat, noted for its exports of incense; and Ainad, greatly to the east, famous for a fair, and for the tomb of an ancient prophet, called Kachtan, or Jaktan, spoken of in the Koran.

The towns of Oman are not worthy of description. It is enough to specify the names of Sur, Kalabat, Kuriat, and Muscat. This last place was formerly of consequence in the hands of the Portuguese, but since their expulsion by the Arabs it has gradually declined. In respect of position, at the mouth of the Persian gulf, it lies well for trade, and seems to court the visitation of strangers. English vessels coming from India not unfrequently touch at it.

Lahsa, the capital of the province so called, on the Persian gulf, is a goodly town by all accounts, but is comparatively little known. There is a pearl-fishery in its vicinity. Some maps lay down a river as entering the gulf at this place. In all probability it is merely a brook, only sometimes filled with rain from the mountains in Neged. Katif, to the north of Lahsa, was once important. The Portuguese had a fortress near it, the ruins of which were to be seen in Niebuhr's time. Koueit, Græn, or Grane, is farther to the north. Its inhabitants carry on a pearl-fishery. Here also the same people had a fortification.

Several islands in the Persian gulf are subject to the Arabs. The towns, or rather villages, of the desert, have little claim to attention.

National character.—It is not easy to give a faithful representation of national character, even where the materials are constantly in the view of the observer, and have become familiar by frequent examination. The manners and the conduct of a few individuals are too apt to obtain undue consequence in his mind; nor is it always practicable, however voluntary and conscientious his efforts may be, to divest himself of prepossessions, arising as well from the peculiarities of his own temper and disposition, as from the education and treatment to which he has been subjected. In general, it may be observed, that professed estimates of character, in the abstract, are either faulty from the causes now mentioned, or partake much more of the fancy and the method of the composer, than the substance and irregularity of fact. A safer, though less splendid delineation, is afforded in the detail of specific manners and customs, which, though by no means exactly either the cause or the consequence of national character, have sufficient power to modify it, and give prominency to its essential features. It is certainly allowable to deduce inferences from these indications, to a certain extent; but in every such process we ought to recollect, that human nature is the same throughout every region in which it is to be found, and that our conclusions must never imply any radical differences of its constituent parts. In other words, we must confine ourselves to the mere varieties of modification under which that nature is presented. These reflexions, obvious and elementary as they are, will be found important in all cases where the diversities of nations are considered, but are more imperatively necessary when every step of our inquiry leads us to some institution or practice quite at variance with our own habits, and indeed, at first sight, utterly irreconcileable with those notions of propriety or expediency with which we have been imbued. The instance before us demands this caution in the highest degree. No two creatures, in fact, appear more unlike than the genuine Arab and a native of any country of Europe; and yet a close investigation of the most glaring dissimilarities will terminate in the conviction, that both have the same origin, and partake of the same nature. But it is time to attend to some of the discriminating features of the former.

Boys, in Arabia, are commonly confined among the women till the age of five or six, when they are removed to the company of their fathers, from whom they acquire a gravity of manner which despises the trifling employments of youth, and a habit of thoughtfulness which scarcely admits the necessity or recognises the influence of ordinary pleasures. They early become men, capable of encountering the difficulties of their lot, and worthy of confidence in those offices and duties to which they are called by their own ambition or the prejudices of the tribe. Their seriousness is quite consistent with vivacity of disposition, though this displays itself rather in promptness of action, where some valuable object is to be obtained, than in the greedy prosecution of licentiousness, or the inordinate demand for trifling amusements. They are fond indeed of company, but apparently for reasons derived from the same source, because it affords room for ingenuity, emulation, and the intercourse of thought, not as administering occasion to intemperance, or encouraging vice by the force of example. A good, but perhaps a partial judge, Sir William Jones, does not scruple to denominate them a "majestic race," and describes them as having "eyes full of vivacity, their speech voluble and articulate, their deportment manly and dignified, their apprehension quick, their minds always present and attentive, with a spirit of independence appearing in the countenances even of the lowest among them." Some explanation, perhaps, may be given of their claims to so high an eulogium. Hitherto, with the exception of those towns and their immediately adjoining districts in which usurpation and tyranny have engendered indolence and debauchery, the Arabs have had to contend almost perpetually for their liberty by personal valour, and therefore no individual has been suffered to think himself exempted from the restraints of military virtue. But it must be admitted, on the other hand, that their excellencies are not without alloy. Nay, they almost necessarily produce some unhappy evils. Thus, the Arabs are vindictive beyond the ordinary measure of wrath, carrying animosity for the greater part of life, and inflicting punishment on the most innocent relatives of the hated object; their pride is so irritable, that it is raised to madness by the slightest disrespect, and so lordly, that it requires the blood of the offender before it can be appeased; their activity is the fruitful source of unjust and cruel aggression; and in the maintenance of their own freedom, wild and lawless as it may be, they would not hesitate to inflict the most degrading slavery on all the rest of mankind. In addition to these most serious charges, which, unfortunately, many particulars in their history serve to substantiate, they have been represented as despicable cheats and arrant hypocrites. But Niebuhr testifies the exaggeration, if not the falsity, of this odious estimate; and it is very certain, from his account, that they are ready to admire the beauty, as well as to admit the value of good faith and honest behaviour. As a warrior, the Arab is entitled to unqualified praise. No danger appals him which it would not be madness to encounter; he appears always confident of victory, but never neglects the means by which it is to be accomplished; and in the midst of the greatest difficulties and suffering, he consoles himself with the certainty of future happiness, should his bravery fail of a present reward. His onset is terrific, overwhelming, decisive; nor is it the least of his martial qualifications, that he has the skill to make his faithful companion contribute to his success by its strength, or ensure his safety by its speed.

State of Women, &c.—The condition of females in this country, is, on the whole, comfortable, though they be denied access to assemblies, as fit only for men, are interdicted music and dancing, as indecent, and are occasionally subjected to the divided regards of their husbands. Polygamy, though allowed, is far from being general, most of the Arabs finding a single wife abundantly expensive for their finances. It is the rich, therefore, who indulge in a plurality, unless in cases immediately to be mentioned, where marriage is a sort of commercial speculation. Divorce rarely occurs, and, indeed, is rather dishonourable, except when the most warrantable of reasons enjoin it. A woman may exercise it, if she find herself ill used. In this case, she is entitled to her dowry, over which, according to the equitable custom of the country, she continues to enjoy the power, even in the married state. It frequently happens, therefore, that a man is dependent on his wife, whom it is consequently his interest to please, and from whom he cannot separate without loss. For these reasons, rich parents will bestow their daughters on poor men, rather than on the wealthy. But it is no less true, on the other hand, that fathers in the lower ranks sometimes add to a list of wives in expectation of presents from their sons-in-law. Marriage, altogether, is eagerly sought by the women, who universally consider it disgraceful to be without children. They will in consequence content themselves with the poorest husband, and even submit to have partners in his affection, rather than incur the reproach of barrenness; and as the men, again, profit by their dowry or their labour, there are few persons who continue single beyond a certain early period of life. Wives possess great authority in their families, and are treated with courtesy and tenderness, which they seem to deserve by their becoming conduct and affectionate solicitude. The women in general are cautious against being seen, and it is thought very unpolite to look them stedfastly in the face, if on any occasion uncovered; yet they will sometimes kiss the hands of a man of distinction, and even kneel to kiss his feet.

Hospitality, &c.—The Arabs are very attentive to strangers, liberal in the distribution of their substance to those who need, and far from being so narrow-minded as to exclude from their friendship persons of very different religious opinions. All creeds indeed are not equally respected, though all be tolerated, in the widest sense of the word. Christians meet with least aversion—then Jews—the Banians of India are most disesteemed;—but any one of these may experience the hospitality and kindness of an Arab whose honour has been engaged by confidence, or with whom he has once had the good fortune to partake of a common meal. It is good policy in a traveller, therefore, as soon as possible to secure Arabian protection by a social repast, the instances of treachery, after such an implied engagement, being too rare to justify the least suspicion. An Arab, in reality, appears to proclaim his hostile intentions by refusing to be entertained.

Salutations are numerous and respectful. 'Salam Aleikum,' 'Peace be with you,' is a common form. They shake hands—a superior suffers his fingers to be kissed—equals embrace—pipes and perfumes are presented at ordinary visits, and guests are sprinkled with rose-water when about to retire. The greatest care is taken to promote and preserve cleanliness of person. Temperance in eating and drinking is almost universally practised; and certain indications of over-repletion or indigestion are reckoned so disgraceful, that a man has been known to fly his country after a transgression which no legislator has ever yet deemed immoral. The superstition of the Arabs induces them to wear amulets and use charms. Their religious worship is performed with commendable humiliation, and is always preceded by stripping off their rings, jewels, and other ornaments. Both sexes are subjected to circumcision in early life.

Language, &c.—The Arabic language, it is well known, is exceedingly ancient. It is no less remarkable for its copiousness and nice adaptation to the varieties and complexity of human thought. The cultivation of it appears to have constituted a national and universal object of regard in the earliest times, and hence an abundance of compositions both written and oral, with which few other countries, if any, can compare. Those dialects which are now in common use, vary very considerably from the language of the Koran, which appears to have been adopted by Mahomet from the tribe of the Koreish, to whom had been committed the preservation of the temple of Mecca, so long the central point of the national faith. Mahomet himself thought so highly of that language, that he sometimes appealed to his book as indisputable proof of his divine mission. Niebuhr thinks the differences of the prevalent dialects equal to those found in the states of Italy, and in a few cases to be about as great as are exhibited by the Spanish and Portuguese.

Reading and writing are common qualifications among those who engage in business; but, on the whole, education is very limited both in kind and quantity. The acquisition of learning does not appear to exalt the consequence of an individual, as, according to Niebuhr, he is rarely, on that account alone, promoted to any higher office than that of a schoolmaster or transcriber. The less fortunate literati are often forced to gain a livelihood by reading or reciting for the entertainment of those who frequent the coffee-houses, a place and species of recreation very common in Arabia. Whatever they were in former times, it is pretty certain that neither poetry nor eloquence is now in a prosperous condition; but the very circumstance just now mentioned implies a degree of taste beyond the sensuality of vulgar minds. Science, formerly also highly cultivated, is equally defective among the Arabs. Their astronomy is little better than a system of astrological quackery, of which they are still the dupes. Other occult studies are in repute; whence we may infer the absence of true philosophy. Medicine is wretchedly practised, and no less wretchedly recompensed. "All the physicians in Yemen," says Niebuhr, "with whom I was acquainted, acted at the same time as chemists, apothecaries, surgeons, and horse-doctors, and yet, by the practice of all these arts together, they could scarcely make a livelihood."

Mode of eating, &c.—The Arabians, like most of the eastern nations, squat themselves on the ground at meals, of which they partake with the hand, not making use of knives or forks. They generally place a long linen cloth under their knees, instead of a table-napkin. However numerous the party may be, it is usual for the whole to put their hands into the same dish in which the victuals are presented. But as they pay the greatest regard to cleanliness, Niebhur says that in reality their mode of eating is little less delicate than that of Europeans. It is managed with surprising rapidity. Among their common dishes are, boiled rice, milk, butter, whipped cream, and pastry of various sorts; animal food is little used; bread made of coarse millet-seed, kneaded with camel's milk and oil or butter, is eaten by the poorer people. Though mills for grinding are known, the Arabs generally prefer the practice of bruising their corn, as yielding a sweeter flavour. The usual beverage is water, either pure or with some simple addition; but strong drink, though forbidden by the Koran, is occasionally indulged in privately, when it can be procured.

Dress, &c.—The ordinary dress of the Arabs is very simple; a large shirt, either white or striped with blue, a loose cloak, or mantle, a pair of drawers, and a kind of turban, which consists of a number of linen or cotton caps. This head-piece is represented as both cumbersome and expensive, the people of rank wearing sometimes no less than fifteen folds, the uppermost being embroidered with gold. It forms an excellent defence against the heat of the sun, which might prove fatal if not thus excluded. The men of learning are often distinguished by the magnitude of their turbans. Sandals are used in place of shoes, but people of fashion wear slippers. The women veil their faces; rings are applied to the nose and ears, as well as to the fingers and arms. It is usual to stain the nails red, to paint the circles of the eyes and even the eye-lashes black, with a metallic preparation called *kochlel*, and the hands and feet are often died of a brownish-yellow colour. The natural complexion is a deep yellow, though persons with fair skins are sometimes seen. The men shave their heads and preserve their beards, but there are various exceptions to both practices. When the latter become white from age, some fanciful folk contrive to give them a reddish hue; the folly of the device, however, is so obvious, that, on the whole, there are not many who adopt it. Fashion exerts her sway here as elsewhere, but, in general, is not very capricious.

The Arabs are of the common stature, and are slenderly made, or, more properly speaking, seldom become corpulent, in consequence, no doubt, of their moderation, or rather abstemiousness as to eating and drinking, and the freedom and frequency of exercise to which they are accustomed.

In concluding the account of this interesting people, it may be proper to mention, that the best traits of the character assigned to them are most certainly found in those parts of the country where the state of society is somewhat between the extremes of ungoverned licentiousness and the oppression of unmitigated despotism. Nothing can be more unjust than to draw their picture from those ruffian bands in the northern boundaries, who have for ages carried on a system of pillage and cruelty, which has invested the name of Arab with the most terrific and detestable associations. The descriptions given of *them* by travellers in Egypt, Syria, &c. are nearly the most hideous pictures of human depravity. One of the last of these we have seen is in Jackson's Account of Morocco, in which are detailed the particulars of the treatment experienced by Europeans, not excluding our own countrymen, be it remembered, who had the misfortune to be taken, by whatever means, either *on* or *off* the Barbary coast, and who, after being plundered, were sold as slaves to these vile miscreants. Britain, it must be allowed, had too long and too supinely overlooked such enormities. Humanity, now somewhat hopeful, waits to learn whether the voice of indignation, at length extorted, shall prove effectual for their prevention.

History.—The early history of Arabia is extremely obscure. It may be traced, with some semblance of probability, to Assyria, one of the first civilized countries of which we have any satisfactory accounts. A tradition among the Arabs themselves derives some of their sovereigns from the neighbourhood of Samarcand. These appear to have been worshippers of fire, and were styled *Tobba*, which was either their family or their official name, like the Pharaoh of the Egyptians. A correspondent opinion, prevalent in Persia, affirms, that the conqueror who founded the ancient capital of that kingdom came also from the same country, and hence is presumed the connexion between the Persians and Arabians. Niebuhr endeavours to confirm this inference by the circumstance of the similarity of character noticed by him in certain inscriptions met with at Mocha and Persepolis; from which, of course, he deduces likewise the identity of language used by these people in ancient times. But there is some imperfection in the evidence, which, though not sufficient to discredit the theory, must necessarily abate the confidence of a cautious inquirer.

It is more certain that, previously to the era of Grecian history, the Arabs had attained considerable power as a nation, in which capacity they acted an important part in the theatre of the world. Thus the shepherd kings, as they are called, who invaded and conquered Egypt, are, with great probability, imagined, by Bryant and others, to have proceeded from part of this region, or at least from the land of Babylonia, which is judged to be the original seat of the Arabs. It was in memory, it is believed, of two of the cities in their own country, that these people, denominated *Auritæ*, from *Aur*, a Hebrew word signifying fire, which was the great object of their worship, built a place of the same name, but corrupted into *Ur*, and Babylon in Egypt. But Memphis was their chief city in that land, into which they appear to have established their own religion. They were

Arabia.

expelled from Egypt after a residence, and indeed a tyranny, of more than 400 years duration.

Of the state and fortunes of Arabia itself in this period, we have only the most vague and imperfect conjectures. During the successive empires of the Persians, Greeks, and Romans, the affairs of this country were almost altogether unnoticed by historians. All of these powers appear to have made attempts, some of them frequently, to subdue it, but with very insignificant success. Thus the Arabs, then, may boast of an exemption from foreign dominion probably unexampled in the records of any other people of equal importance in civilisation. Their independent constitution of government was not less singularly prolonged. It does not appear that Arabia was ever united under one head till the period of Mahomet and his immediate successors; and even then the union was merely nominal with respect to several tribes. Kings of the *Hamjare* or *Hamiar* race, it is true, reigned over considerable parts of it, more especially Hadramaut; and the provinces of Yemen, besides having been repeatedly and successfully invaded, as Gibbon notices, were also occasionally governed by one sovereign. But the rest of the country, and particularly the internal districts, must be allowed to have continued free from both species of subjugation. This remarkable peculiarity in Arabian history, has been treated of by the writer now named, with his wonted vigour and sagacity; but he has not suffered the exceptions just hinted at to escape him, without a sarcastic sneer at the indiscretion of certain authors, who had drawn conclusions from the Arabian independence in support of a system, which neither required their officiousness, nor can be injured by his malignity.

Religion of Mahomet.—Though both the Jewish and Christian religions had been introduced into Arabia before the time of Mahomet, the former, probably, by Jews from Ethiopia, whither they had fled from Roman enmity, and the latter at least as early as the middle of the third century, if not at the very commencement of its success among the heathens, it does not appear that his countrymen had advanced far in refinement of manners, or the cultivation of the arts and sciences. Some of the chief nobility, it is likely, and the men of learning, were so far enlightened as to have become pure theists. But their influence was very small over the prejudices and stupidity of the vulgar mass, which still remained sunk in contemptible idolatry. A system, which, without violently opposing popular indulgencies, inculcated opinions become fashionable among the great, had some reasonable chance of succeeding with a people of lively intellect and warm imagination. Mahomet, accordingly, seems at first to have relied entirely on the power of persuasion in promulgating his doctrines; and it is highly probable, that at this time he himself had the firmest belief in the truth of what he taught. But the conversion of about fourteen persons in the space of three years, did not correspond with the enthusiasm of his feelings. He now gave himself out as a prophet, and perhaps thought that he was one. In the course of ten years following this assumption, he laboured publicly, and with considerable effect, especially among his fellow-citizens of Mecca. His success at length alarmed the friends or interested adherents of the ancient idolatry, particularly the Koreish, from whose determined opposition and threatenings he was induced to consult his safety by retiring to Medina. This flight, which took place in the year 622 of the Christian era, from its mighty consequences, became the epoch of his disciples, under the name of *Hegira*.

Arabia.

Propagated by arms.—At Medina, where his pretensions had already been known and admitted by many, Mahomet endeavoured for some time to conciliate his opponents by gentle means; but as these did not answer his expectation, and as there appeared a necessity for vigorous measures to ensure his welfare and the extension of his cause, he had recourse to arms, and asserted the duty of combating for the faith. The sword was found quite agreeable to his doctrines, and a much fitter instrument for making converts than any he had hitherto employed. Victory followed victory, and in a few years the banners of the crescent waved over all Arabia. Mahomet died in 632, at Medina, where he commenced his military career, and which henceforward was sacred to his memory, though, for reasons already assigned, and after having failed to procure the countenance of the Jews, by appointing Jerusalem as the place to which prayer should be addressed, Mecca was still regarded as the holy city. His countrymen, now united in his faith, and acknowledging him for their spiritual head, were not by any means altogether subjected to his temporal power. Some tribes, on the contrary, no way diverted from the love of freedom by fanaticism, maintained their independence under their own chiefs, both during his lifetime and in the reign of his successors. This anomaly was most conspicuous in certain provinces bordering the Red sea, and seems strangely inconsistent with the rapid and wide spread influence of so militant and domineering a religion.

Causes of its success.—The causes of the extraordinary success which attended the doctrines of Mahomet, have not been well understood. "That a victorious imposture should continually extend its influence," says a late very judicious writer, "amidst the deplorable dissensions which then dishonoured the Christianity of the east, may be easily comprehended; but the question is, how it acquired sufficient strength to become a victorious imposture." The ignorance of the Arabians, and the disunion of their numerous tribes, to whatever degree they may be supposed to have amounted, explain rather negatively the comparatively little resistance which he experienced at his outset, than positively the facile adoption of his opinions, which perhaps, had they been of another description, would have met with universal apathy and contempt. That catholic adaptation of his creed to the peculiarities of every existing system, which is one of the most striking features in his missionary conduct, is scarcely adequate to the difficulty; because, as is noticed by the same writer, his success was obtained at Mecca, whereas the Christians and Jews, whom he was so anxious to placate by his condescension, resided chiefly at Medina. The solution, therefore, is sought for "in the intrinsic merit of the doctrines which he preached." "To ignorant heathens," continues Dr Millar, "he taught doctrines which were borrowed from the pure system of divine revelation, much debased indeed, but still far nobler, and more worthy of attention than the rude tenets of their native paganism; and ignorant as they were, and incapable of forming a just judgment of his pretensions to divine authority, these heathens were yet in that state of pastoral refinement in which they could be captivated by the charms of eloquence, and be struck with the sublimity of the scriptural descriptions of God. The religion of Mahomet is, in reality, a coarse modification of divine truths, brought down to the capacity of barbarous nations; and was probably better adapted to their moral regulation, than the contentious and paganized Christianity, which alone preserved among them the memory of the gospel." [*Philosophy of Modern History, Dublin* 1816.]

This specious elucidation, so complimentary to human nature and the sagacity of Mahomet, seems to require material qualification before it can be adopted as even partially correct. Its justness is rendered questionable by a fact noticed by the author himself, viz. the small success which Origen enjoyed in his labours to proclaim the doctrines of a work from which it is admitted that Mahomet derived his most important sentiments. In our opinion, the chief influence is to be ascribed to the novel circumstance of a native Arab displaying the ceaseless energy and the solicitude of an apostle, which could not fail to produce a very general conviction of the really interesting nature of his communications.

Successors of Mahomet.—Mahomet had named Ali, his son-in-law, for his successor. But Abubeker, whose daughter he had married, frustrated his intention, by gaining over the army to his own interest. This able man prosecuted the military plans of the prophet, and extended the new faith beyond the boundaries of Arabia. Jerusalem and Damascus, at this time part of the eastern empire, yielded to his arms. The reduction of Persia was effected in the reign of his successor, Omar, who was elected to the caliphate by the splendid and significant title of Emperor of the Believers. This important conquest proved advantageous to the Arabians in another manner than by merely extending their dominion. It rendered them in fact the willing disciples of a people much more advanced in refinement than themselves, Persia proving to them what Greece had been, in an earlier age, to its masters the Romans.

Omar was murdered by a Persian during his devotions at Medina. The caliphate was then filled by Othman, on whose death, Ali, who, from prejudice, or other not well understood reasons, had been deferred, succeeded to sovereign power. His reign was splendid, though of short duration, and full of trouble. Hasan, his son and successor, was speedily deposed, and afterwards murdered. During these five caliphs, Medina continued to be the seat of government. The new race of the Ommiades chose Damascus for its residence, and has consequently been denominated the Syrian Dynasty. It lasted for about 90 years, when it was succeeded by the Abbassides, the descendants of Ali, who built Bagdad, on the Tigris, where they reigned for nearly five centuries, the last of the caliphs being put to death by the Tartars, at the capture of that place, in the middle of the 13th century. This long period, which coincides with the dark ages of European history, was illustrated by the brightest efforts of Arabian literature and science, though the caliphate had lost its military importance and extensive empire. The names of Haroun al Raschid, so signalized in that marvellous work the Arabian nights tales, and his son Almamon, the munificent patron of learning, adorn the list of the Abbassides.

The Mahomedan religion, with various modifications and sundry dissentions, now prevailed from Hindostan to the northern regions of Africa, and had actually extended through Spain to the Pyrenees, if not into France, as far as the Loire. But these diversified regions acknowledged a variety of sovereigns besides the caliphs of Bagdad, whose influence at last became a mere shadow of what it had once been.

Arabia, enjoying a state of independence under its indigenous chiefs, appears to have remained much unnoticed till the arrival of the Portuguese in the Red sea, subsequently to their discovery of the course to India by the Cape of Good Hope. This induced the sultan of the Mamalukes, El Gury, to fit out a naval force, for the purpose of opposing them, and which, availing itself of the opportunity, seized almost all the sea-ports in that sea belonging to the Arabs. These places fell again, for a short time, into the hands of the natives, when the Turks established their power in Egypt, but were afterwards taken possession of by that people, under Soliman Pacha, whose successors pushed their conquests over a great portion of Yemen, henceforward considered a province of the Ottoman empire. But the spirited chiefs of the interior defied the ambition of these new enemies, and by a bold resistance, followed up by repeated attacks, drove them to the coasts, which they were at last compelled to abandon, with the exception of a few places where they retained a mere semblance of authority. Even this may be said to have vanished, in consequence of some recent events.

New Religion.—It has been mentioned, that a new religious sect has lately arisen in Arabia, deriving its origin and name from Waheb. Its progress, the rapidity of which has been so alarming to previous establishments, is the only remaining portion of the history of this country deserving minute attention.

But we have to regret that the accounts of it hitherto published are both imperfect and contradictory. Abdul Waheb was a native of El Aiane in the province of Nedjed-el-Ared. After having finished his study of the sciences in Arabia, and travelled through Persia, he undertook to reform the religion of his country, condemning a variety of abuses, and endeavouring to introduce greater simplicity of faith and greater purity of conduct. Without derogating from the honour of the prophet as a divine teacher, he insisted on confining worship to the Supreme Being alone, of whom it seems pretty certain he entertained more correct notions than the Mahometans in general, though it be scarcely possible, from the information we have respecting his principles, to ascertain his peculiar sentiments. The doctrines of Waheb were eagerly adopted by some of the tribes, and shortly his influence began to be felt throughout

Arabia. a great part of Arabia. Opposition, of course, arose among the retainers of the ancient creed, who, as is usual, denominated reformation heretical, and thought it most convenient as well as most commendable to abide by an established faith. His enemies did not find him unprepared when they attacked him with an armed force in his native city. He obtained a victory over some thousands, which had the double effect of confirming his doctrine and augmenting his power. No wonder that it also excited his ambition and animated his efforts.

Success often inspires wisdom as well as energy. Waheb appears to have possessed both in a considerable degree. He now declared his opponents to be enemies of religion, and liable to punishment in their persons and estates; and as his ability to inflict it was already great and on the increase, several persons of the highest importance saw it expedient to submit to his authority, and to attempt the promotion, or at least the preservation of their own interests, by contributing to his measures. Thus his followers, originally consisting of the lower orders of the people, whom a specious delusion and the hopes of a favourable change had united under his banners, were rapidly increased, and obtained respectability of character from their consequence as well as their number. The whole of Neged declared in their favour, and Yemen now became the theatre of their successful exertions.

Progress of the Wahabees.—Mecca yielded to their arms in 1803, on which occasion they are reported to have committed the most enormous excesses and cruelties. From this city the chief of the reformers wrote a letter to the sultan, reminding him that the title of Caliph belonged to the protector of the holy city, and that therefore the dignity attached to it devolved on himself as the conqueror. The Ottoman armies, already in march against these enthusiasts, were unable to withstand their progress, almost all Arabia having espoused their cause, which was acknowledged also and maintained throughout many other parts of the sultan's real or nominal dominions.

The capture of Medina, now projected, seems to have been prevented by the breaking out of the plague and the small pox among the insurgents, who were even obliged to retreat into the desert, leaving only a few hundred men to garrison Mecca, which was soon retaken by the Turks. A truce followed, but was probably deceitfully entered into by both parties, as in a short time hostilities recommenced, and the interval seems to have been spent in animosities and mutual preparations for another contest. At what time the death of Waheb happened we have not been able to learn, the works from which we have hitherto derived our information differing in their statements. It seems to have been occasioned by the malice, or the zeal, of a fanatic, employed in the service of the Ottoman Porte.

Abduluziz succeeded his father in leading the new religionists to avenge the murder of their founder, and to establish his cause. In spirit, ambition, and intelligence, the son appeared to merit this distinction; nor did his fortune, at first at least, belie his exertions. Mecca was re-captured, and Medina taken, but he himself was assassinated at Darail by one of his countrymen, whose daughter he had long before carried off by force, and who had continued with most persevering diligence to seek a fit opportunity for revenge. The religion of Waheb was now most extensively spread, and seemed to defy farther opposition. Suud, the son of Abduluziz, was recognized as its head. It is by this person, we ought to observe, according to one account, that the capture of the two cities, Mecca and Medina, above mentioned, and the accomplishment of several objects were effected, which by others have been ascribed to his father and grand-father.

The conquest of Mecca, by whomsoever made, may in one sense be considered the death-blow to the superstition of Mahomet. This city, for more than a thousand years, had received the prayers and the gifts of the faithful; and during all that period was not once entered but with the intention of contributing to its glory and prolonging its claims to veneration. "It appears to me almost certain," says Mr Scott Waring, in the Account of his Tour to Shiraz, &c. that the pilgrimages to Mecca have had nearly as great an effect in supporting this religion, as the first victories and conquests of Mahomed." What substitute can be adopted for so essential a bulwark? Who, among the multiplied and greatly discordant followers of the prophet, is either entitled or able to supply its place, or to remedy its loss? Even the recovery of his temple, and the purgation of it by the blood of his enemies, which their present supremacy and augmenting force render a very improbable event, could not wipe away this calamitous stigma, nor vindicate the sacredness and the efficacy of the law which forbids the approach of armed men within a certain distance of its walls. Despair, then, and contempt may finish what selfishness and rebellion commenced; and, ere long, a system, to the dominion of which no limit could be discovered in the credulity or the patience of so great a proportion of mankind, may moulder down into the vanity of dead and forgotten things. "All they that take the sword shall perish with the sword," is a maxim more peculiarly applicable to every religion which promotes conversion by violence, and accepts of slaves for disciples. There must and will come a time when blood shall cry for blood, and will be heard by Him whose prerogative has been impiously assumed.

Reflections.—It is not our province to discuss the politics of the times, nor would our readers probably be inclined to relish conjectures and prophecies at our hands. We relinquish the labour; but it may not be altogether improper to hazard a reflection on the expediency of Britain aiding the efforts of the Arabs, under the new religion, to maintain and to embellish their independence. We cannot but regret that the friendly solicitations repeatedly addressed by the Wahabee powers to the government of Bombay have hitherto been totally disregarded. This we learn from the travels of Lord Valentia, to whom we are indebted for much of the information we possess of the curious transactions of these people. There was a period, certainly, within the times in which these applications were made, when no alliance with the Ottoman court could have been pleaded in excuse for such negligence. Nor do we conceive that any assistance, of the nature required by them, could at all, even during such an alliance, be construed into an infraction of it; though it were, the offence, we presume, would not entail any very formidable evils. The Arabs were surely entitled to the common respect generally paid to independent nations, however they may have contrived to be ranked among them, and have every right to wish and endeavour to promote their own welfare. This, we think, may be effected without injury to ourselves, probably with advantage. Here it may not be ill-timed to suggest, as some evidence of this opinion, the decided benefit which might have already resulted from a different line of policy than that which has been adopted. The indignation of Britain was lately poured out on some of the worse than savage monsters of the Barbary states, and all Europe joined in expectation of the completeness and rapidity of the retribution which should redeem her long and humiliating torpor. Would it not have been judicious to have previously obtained the good understanding of the Arabs, with whom they trade, and who, notwithstanding their participation in the traffic of human flesh, are accustomed to treat them, especially the Algerines, with the most sovereign contempt? We can have no doubts on the subject, nor can we hesitate to extend our views much farther, so as to anticipate a most salutary revolution in the affairs of the eastern world as the consequence of our interference.

ARABIC GUM, a gum which exudes from the *Mimosa Nilotica*, probably was thus denominated because it was originally imported from Arabia. See CHEMISTRY and MATERIA MEDICA.

ARABIS, Bastard Tower Mustard, a genus of plants belonging to the Tetradynamia class, and order Siliquosæ.

ARACAN, a region of Asia, on the bay of Bengal, which was subdued by the Birmans in 1783, and became a province of their empire; is bounded on the east by the Birman empire, and on the south by Pegu, and presents a diversified aspect of lakes, rivers, mountains, and plains. The soil in the flat country produces excellent rice, the richest fruits of tropical climates abound, and the mountainous pastures feed numerous herds of cattle. The buffaloe, the elephant, and the camel, are substituted for horses in the labours of agriculture, as well as for domestic purposes. The northern districts of Aracan, possessing a fine climate and a rich soil, are covered with opulent towns and populous villages; but the southern part is a wild and inaccessible desert, the undisturbed abode of tigers, buffaloes, and elephants. The natives are in a state of great barbarity and ignorance; and in religion and manners resemble the other uncivilized nations of the east. The Dutch and Portuguese formerly had a considerable trade with this country; but it is now transferred to resident Mahometan merchants, who exchange cloth, cotton, pepper, iron, steel, &c. for elephants, ivory, tin, stick-lac, and precious stones.

ARACAN, the capital of the province of the same name, occupies a remarkable spot on the banks of a river; is surrounded by lofty and rugged mountains, which form a natural fortification, through which the entrances and gates of the city are cut in the solid rock; and it is distant 50 miles from the sea. The population, now about 16,000, is said at one time to have been equal to 160,000; and the city was 15 miles in circuit, contained 600 temples, and a splendid palace, richly decorated with golden ornaments. The river, also called Aracan, traverses the city, and forms a most capacious harbour, which admits ships of the largest burden; but as the tide rises from 15 to 20 feet, the current of the stream is extremely rapid. N. Lat. 20°, 45.′ E. Long. 93°, 5′.

ARACHIS, Groundnut, a genus of plants belonging to the Diadelphia class.

ARACHNE, the inventress of the art of spinning and weaving, according to ancient mythology, was a maid of Lydia, and had reached such perfection that she ventured to become the rival of Minerva. The goddess of wisdom was offended at the presumption of a mortal, tore her work, and chastised her with blows. Driven to despair by this rude treatment and disgrace, she destroyed herself; but Minerva, regretting the violence, and moved by compassion, restored her to life, and transformed her into a spider, which still exercises the same trade.

ARACK, a spirituous liquor prepared by distillation in the East Indies. See ARRACK.

ARÆOMETER, from the Greek words signifying *rare* or *light*, and *measure*, is an instrument for determining the specific gravity of liquids, and is analogous to Hydrometer. See HYDROMETER.

ARÆOPAGUS. See AREOPAGUS.

ARAFAT, signifying *the mountain of knowledge*, is a mountain near Mecca, in Arabia, which is held in great veneration by the faithful. The Mahometans suppose that Adam and Eve, after their expulsion from paradise, and a separation of 120 years, met on this mountain; and part of the solemn devotions which are required of those who make the pilgrimage to Mecca, is performed on the ninth day of the last month of the Arabic year, on this sacred spot. With uncovered heads, and with every other expression of humility and mortification, they spend five hours of the evening of this day on the mountain; and having received the honourable appellation of *hadgis*, which is conferred by the priest, and belongs to those who have proved their piety by this extraordinary ceremony, they retire to Mecca.

ARAGON, a province in Spain. See ARRAGON.

ARAL, a lake, or inland sea of Independent Tartary, and 120 miles to the eastward of the Caspian sea, from which it is separated by an elevated plain, is above 100 miles in breadth, and more than 200 miles in length, from north to south. The western shores are high and rocky; and the rivers Sirr and Gihon, the ancient Iaxartes and Oxus, discharge their waters into this lake; and the same kinds of fish which frequent the Caspian, are found in it. Having no visible outlet, the waters are strongly impregnated with common salt, which is extracted by spontaneous evaporation. The *Lake of Eagles* is an appellation sometimes applied to lake Aral.

ARALIA, or ANGELICA TREE, a genus of plants belonging to the Pentandria class.

ARANEA, the spider, a genus of insects arranged under the Aptera order. See ENTOMOLOGY.

ARANJUEZ, a town in the province of New Castile in Spain, which has been selected as a residence of the royal family, occupies a charming spot on the banks of the Tagus, is about 20 miles from Madrid, and during the visit of the court in the spring season contains about 10,000 inhabitants. From an inconsiderable village, Aranjuez has been converted, in little more than half a century, into an elegant town, with spacious squares, broad streets, and fine houses. A magnificent church is erected in the principal square, which is also adorned with a splendid fountain for supplying the town with water. The amphitheatre, for the exhibition of bull fights, is a brick building, 160 feet in diameter. The palace, originally erected by Philip II. and improved by succeeding sovereigns, has nothing striking in its external aspect. Among its internal decorations are enumerated the Annunciation by Titian, and other excellent specimens of the productions of celebrated painters. But the royal gardens, watered by the Tagus, and unrivalled in extent and variety of scenery, exhibit the most splendid assemblage of all the beauties of nature and art.

ARAR, the modern Saone, a navigable river of Celtic Gaul, mentioned by Cæsar, and over which his soldiers built a bridge in a single day. The Arar joins the Rhone a little below Lyons.

ARARAT, a mountain of Armenia, on which it is supposed the ark of Noah rested after the diminution of the waters of the deluge. Numerous conjectures have been offered concerning the position of this mountain. According to some, it is one of the mountains which divide Armenia from Mesopotamia, and border on Assyria; but others describe mount Ararat as a detached mountain in the middle of Armenia, which, from an extensive plain, rears its double summit in the form of a sugar-loaf, and is covered with perpetual snow. Large masses of sandstone and loose sand compose the lower regions of the mountain; a few stunted shrubs include the whole of its vegetable productions; and on one side a deep chasm adds to the gloomy aspect of this sterile scene. See *Tournefort's Travels.*

ARATUS, a Greek poet, was a native of Cilicia, flourished about 270 years before the Christian era, and was the author of a poem entitled *Phænomena,* which contains a detail of the astronomical opinions of the ancient philosophers. This poem was translated by Cicero; but a fragment only of his translation has been preserved. A translation by Germanicus Cæsar, as well as the original poem, is yet extant; and the quotation of St Paul, in his address to the Athenians, "For we are also his offspring," (Acts xvii.) is from this poem of Aratus.

ARAU, or ARAW, a town of Switzerland, which stands on the right bank of the Aar. The inhabitants, amounting to about 2000, are chiefly employed in the manufacture of cotton stuffs, printed calicos, ribbons, cutlery ware, and in tanning. The soil of the surrounding territory is rich and fertile, and the scenery is picturesque and beautiful.

ARAUCANIA, a territory of South America, extending along the shores of the Pacific ocean about 200 miles southward, from nearly the 37th degree of south latitude, and stretching more than 400 miles inland towards the Andes, the lower regions of which are included within its limits. The face of the country is variegated with extensive plains, some parts of which are distinguished by their fertility and luxuriance of vegetation, mountainous districts, the loftier parts of which are covered with perpetual snow, thick forests, and spacious lakes.

The inhabitants of Araucania are a warlike race, and have successfully resisted every attempt of the Spaniards to reduce them to subjection. Retaining all their primæval manners and customs, they seem to have made scarcely any progress in civilization since they were first known to the adventurers from the Old World; but they have been singularly fortunate in having historians who, with little discrimination, ascribe to them great wisdom and intelligence in arts, religious sentiments, and political establishments. Even the term Science has been preposterously applied to the very simple attainments of a rude and barbarous people. They have no written language; they believe, it is said, in one Supreme Being, but they have subordinate deities, and especially a god of war, which is quite characteristic of those feelings which their mode of life is most apt to excite. Their government is somewhat of a republican form; they live in scattered villages; their food is chiefly vegetables, as potatoes and corn, but, when opportunity offers, they indulge in drunkenness; their medical knowledge, which has been dignified with the name of science, is limited to magical incantations; and a modern anatomist would surely smile when he is told, that a people, whose only lancet is a sharp flint fastened to a stick, have some skill in dissection. In their marriages, the destined wife is carried off by force, and polygamy is only limited by the means of support; and human sacrifices, usually prisoners taken in war, are offered to their deities. With all the vices of a rude people, the Araucanians possess none of the virtues which entitle them to the extravagant praise which they have received. Their chief manufacture is the *poncho,* or cloak, made of the wool of the *Llama,* or Peruvian sheep, and some of them are of a very fine quality, and bring a high price. These cloaks form a considerable branch of trade with the Spaniards; and it is conducted chiefly by barter.

ARAXES, now ARAS, a river which forms the boundary between Armenia and Media, has its sources in mount Caucasus, is remarkable for the impetuosity of its current, and after a course of 500 miles falls into the Caspian sea. It is subject to inundations in summer, from the melting of the snows in the elevated regions from which its waters are supplied.

ARBA, or ARBE, an island in the Adriatic sea, and lying in the gulf of Carnaro, is about 30 miles in circuit, and is annexed to the Austrian territory. It produces corn, wine, and oil; and large quantities of firewood are exported to Venice. Sheep, hogs, and a good breed of horses, are reared, and, with wool, silk, tunny, and mackerel fisheries, form a considerable trade. The whole population is estimated at 3000, of which 1000 occupy a city of the same name, which stands on a peninsular eminence between two harbours.

ARBELA, now Irbil, a city of Assyria, whose name has been transmitted to posterity along with the record of the celebrated and decisive victory which Alexander the Great obtained over Darius, whose army, it is said, amounted to the unwieldy force of 600,000 men, while that of the Macedonian hero was not equal to 50,000. The conqueror lost only 500 men; but 40,000 of the Persians were left dead on the field.

ARBITER, a person chosen by consent of parties, according to the practice of the civil and Scots law, who is authorised to perform the duties of a judge in deciding differences. The office of arbiter being voluntary, no person could be forced to undertake it; but having once accepted, he might, by the Roman law, be compelled to pronounce a decision. Arbiters have no legal jurisdiction, and therefore cannot order witnesses to give evidence, or the production of written deeds; but this power is supplied by the Court of Session in Scotland, who grant warrants for such purposes, on the application of either of the parties, or of the arbiters themselves. When the authority entrusted to arbiters to determine any case is limited to a fixed period, no judgment pronounced after that time is binding; but when the award or decreet-arbitral is conformed in all respects to the terms of the submission, unless fraud or corruption be alleged and proved, it is final, and not subject to the review of any court. If two arbiters be chosen, and they do not agree in their award, they have sometimes the power of naming an umpire, whose sole decree is equally valid with the original arbiters.

ARBITRATOR, is generally synonymous with arbiter; but the civil law makes some distinction. The arbiter, it is understood, decides according to the rules and practice of law; but the arbitrator judges in the case according to his own discretion, or as he is guided by the principles of equity.

ARBOIS, a town in the department of Jura in France, which has a population exceeding 6000, and has been long famous for its white wines, which are a very considerable source of trade, and are well known throughout the kingdom.

ARBUTHNOT, John, a learned physician and miscellaneous writer, was born near Montrose in Scotland about the commencement of the reign of Charles II. was educated at the university of Aberdeen; and having been admitted to a degree in medicine, he removed to London, where, it is said, he taught for some time mathematics, in which he had risen to considerable eminence. But while he occupied his literary industry, which seems to have been always active, in various investigations, he made rapid advances in professional employment and reputation. He was first appointed physician to Prince George of Denmark, and afterwards physician in ordinary to Queen Anne; and although, on the death of the Queen, his connexion with the court was dissolved, his medical practice continued extensive and lucrative to the end of his life.

Dr Arbuthnot flourished during the bright era of English literature, and was one of that constellation of wits which shed an unfading lustre on the annals of their country. He was the intimate friend and associate of Pope, and Swift, and Gay. No man possessed more varied talents than Dr Arbuthnot. His "Examination of Woodward's Account of the Deluge," his "Treatise on the Usefulness of Mathematical Knowledge," his "Tables of Ancient Coins," &c. and two works immediately connected with his own profession, "On Aliments," and "The Effects of Air on Human Bodies," afford ample proof of his learning and medical knowledge; his talents for wit and humour are abundantly conspicuous in the "History of John Bull," those parts of the "Memoirs of Martinus Scriblerus" which relate to anatomy, and delineate ancient manners and customs, and "A Treatise concerning the Scolding of the Ancients," and the "Art of Political Lying;" but it is alleged that the delicacy of his satire is not always free from asperity, especially when the influence of party spirit prevailed, as in his attack on Bishop Burnet, his political opponent, and in the bitter invectives in the famous "Epitaph on Colonel Charteris." But, independent of his own literary labours, the name of Arbuthnot, as it is commemorated by his distinguished friends and associates, will be transmitted to posterity along with their works. Pope has addressed to him the "The Prologue to the Satires;" and Swift, who said of him, "that he has more wit than we all have, and his humanity is equal to his wit," has eulogised his knowledge and benevolence;

> "Far from his kind Arbuthnot's aid,
> Who knows his art, but not his trade."

A severe asthma, which induced a dropsical affection, terminated his life in London in February 1735. Distinguished by his attainments in science and literature, he was not less eminent for integrity, benevolence, and piety.

ARBUTUS, or Strawberry-tree, a genus of plants belonging to the Decandria class, one species of which, *arbutus unedo*, a beautiful evergreen shrub, is a native of the western districts of Ireland, and is a fine ornament to the picturesque scenery of the lake of Killarney.

ARC, Joan of, better known by the name of the *Maid of Orleans*, acted a conspicuous part in France, in one of the severe struggles against the English invaders, and was born about the beginning of the 15th century. While in her 27th year, and in the humble capacity of servant at an inn in the village of Domremi, the disastrous fate of her country had made a strong impression on her mind; and fancying that she was commissioned by heaven to be the deliverer of the kingdom, under this enthusiasm she appeared before the governor of Vaucouleurs, who presented her to the French court; and when she was introduced to the king, she declared, in the name of the Supreme Creator, that she would raise the siege of Orleans, and conduct him to Rheims to be crowned. Her extraordinary enthusiasm was variously regarded. While some doubted the reality of her mission, a council of divines and learned men pronounced her inspiration to be supernatural; and the superstition of the times, or the sagacity of individuals, employed her as a fit instrument to rouse the drooping energies of her country. Arrayed in military attire, and displaying a consecrated banner, she headed an army sent to the relief of Orleans, entered the place with a convoy, and successfully attacked the English, who were panic struck, and precipitately raised the siege. After various successes, she proposed to proceed to Rheims, to perform the other part of her mission. The attempt was full of hazard, but she had now inspired unbounded confidence, and no enterprise, however arduous, was dreaded. With an army of 12,000 men she marched towards Rheims, which, as well as the country through which she passed, was then in the hands of the English, but their progress was unmolested; the enemy fled before them, and the keys of the city were presented on their arrival; the king was crowned and anointed; and as a mark of royal favour for her extraordinary services, her family was ennobled.

The Maid, having accomplished her mission, was desirous of retiring to her own proper station; but the French general, aware of the importance of her services, encouraged her to remain in arms till the final expulsion of the enemy. She threw herself into Compeigne, which was closely besieged; the garrison thought themselves invincible in her presence; but in an unfortunate sally she was taken prisoner. Her fate was now sealed. Loaded with irons she was carried to Rouen; and under the authority of the Duke of Bedford, regent of the kingdom, she was charged before an ecclesiastical court with impiety and sorcery; and being convicted, she was condemned to the flames, and suffered that unjust and cruel punishment, which was dictated partly by the superstition and partly by the barbarity of the times, in 1435.

The short but eventful story of the Maid of Orleans, has been the subject of various works both in prose and verse. Voltaire and Chapelaine have delineated her heroical exploits in French verse; and more lately, Mr Southey, a bard of our own country, has wrought up the adventures of Joan of Arc into an epic poem.

ARCA, or Ark-Shell, a genus of bivalve shells. See Conchology.

ARCADE, denotes any opening in a building which is formed by an arch.

ARCADIA, a mountainous district of Peloponesus, which occupies the central parts of that peninsula. The face of the country is uneven and rugged; it is watered by numerous streams; the more elevated regions are clothed with verdant herbage, and the soil of the vallies is rich and fertile. Corn has been sometimes raised; and the vine and the olive are enumerated among its spontaneous productions; but flocks and herds have always constituted the chief wealth of the Arcadians. In the early history of Greece, Arcadia holds a conspicuous place; and her sons have never failed to distinguish themselves by their prowess in defence of their own liberties or in the general cause.

Arcadia may be regarded as the native scene of pastoral poetry, and of many of the incidents of ancient mythology. The rivers flow in numbers, and

"Not a mountain rears its head unsung."

Cyllene, Erymanthus, Olympus, and Stymphalus, are familiar to every classical reader. The celebrated Styx is one of the rivers of Arcadia. The coldness and noxious quality of its waters diffused the chill of death over every living thing that tasted or approached them; and no oath was held more sacred among gods and men than when it was solemnly sanctioned by this stream.

ARCESILAUS, a Greek philosopher, who flourished about 300 years before the Christian era; was the disciple of Aristotle, Theophrastus, and Cantor, at Athens, and the founder of the *second school*, or *middle academy*. Science, according to Plato, should be directed, not to external objects which affect the senses, but to the pure objects of intellect, as they have existed as ideas or forms in the divine mind from all eternity. The inference from this doctrine shewed that no certain knowledge could be obtained from sensible objects. But Arcesilaus proceeded farther, and maintained, that every thing is uncertain to the human understanding. Truth and error have no distinctive characteristics; and the powers of man furnish him only with probable reasonings and opinions, but which, he admitted, are sufficiently calculated to guide him in the ordinary affairs of life.

ARCH, any part of the circumference of a circle or curved line.

ARCH, a mode of constructing buildings. See Architecture.

ARCHANGEL, a considerable town, and capital of a province of the same name, in the northern part of the Russian empire, stands on the eastern bank of the river Dwina, which discharges its waters into the White sea, and is described as three miles in length and about a mile in breadth. The streets are in general narrow, and the houses are chiefly built of wood. The town-house is a substantial structure of hewn stone, and consists of three stories. In the more flourishing periods of its history, Archangel reckoned 30,000 inhabitants, but the number at present is not estimated higher than six or seven thousand.

Archangel was discovered by the English in 1553, in an expedition under Sir Hugh Willoughby, which was sent out to explore a passage by the north of Europe to China and the East Indies. The only ship belonging to the expedition which escaped the rigors of a northern winter, had taken shelter in a bay near the spot on which Archangel was afterwards built. Captain Chancellor, the commander, was hospitably received by the Russians, invited to Moscow, and honourably entertained, and entered into a treaty which conferred upon the English the high exclusive privilege of trading in all parts of the Russian territory, free of every kind of duties. Archangel rose into importance, became the emporium of Russia, and of a lucrative commerce to the English, and continued to enjoy its full share of prosperity, with some slight interruptions from the commercial interference of the Dutch, till Petersburgh became the seat of the imperial government, and the commencement of the Baltic trade. In the flourishing period of the history of Archangel, an annual fair was held in August, at which assembled merchants from every part of that wide empire, to meet the English and other traders, from whom they purchased by barter, or for money, broad cloths, linens, silk and woollen stuffs, paper, lace, toys, cutting instruments, and colonial produce, and gave in exchange tallow, hides, feathers, yarn, silk from China and Persia, furs, bristles, caviar, rhubarb, potash, iron, corn, lintseed, and flax.

Many of the commodities above enumerated have found less circuitous channels, and, being withdrawn from Archangel, have greatly diminished its prosperity. But it is still the seat of trade for the productions of the northern and western parts of Siberia, from which valuable furs and abundance of iron are obtained; and the fisheries of the White sea and the Frozen ocean furnish large quantities of stock-fish to be added to its imports. N. Lat. 64° 34′. and E. Long. 39°.

ARCHBISHOP, a church dignitary of the highest order, was not known in the east till the year 320, and was at first only a personal title of distinction, conferred as a mark of respect on the bishops of large cities. At a later period archbishops became metropolitans, and had jurisdiction assigned to them. Four orders, or degrees, which were afterwards introduced, namely *patriarchs*, *archbishops*, *metropolitans*, and *bishops*, composed the ecclesiastical hierarchy. In Italy, and some other parts of the continent, the distinction between metropolitan and archbishop still exists. The latter often holds the title, but without the authority and jurisdiction which always belong to the former. Beside the superintendence of the bishops and clergy of his own province, the archbishop exercises episcopal jurisdiction in his own diocese.

The ecclesiastical government of England is divided into two provinces, Canterbury and York. The archbishop of Canterbury is styled *primate* of all England; previously to the year 1152 his jurisdiction extended to Ireland, and it is supposed included Scotland and the isles. He is the first peer of the realm, takes precedence next to the royal family, and it belongs to him to crown the sovereigns of England. Austin, appointed by King Ethelbert in 598, was the first who filled this see. The archbishop of York is next in ecclesiastical dignity, has precedence of all dukes not of the blood royal, and excepting the Lord Chancellor, of all the great officers of state, and he has the privilege of crowning the queen-consort. Paulinus was the first archbishop of York, and he was appointed by Pope Gregory in 622.

The ecclesiastical establishment of Ireland consists of four archbishops, namely, Armagh, to which the primacy is annexed, Dublin, Cashel, and Tuam. While the episcopal form of church government existed in Scotland, St Andrews and Glasgow were archbishoprics. The former was invested with the authority of metropolitan in 1470 by Pope Sextus IV.

ARCHDEACON, a dignitary in the church of England, next in rank to the bishop. The archdeacons of England amount to sixty.

ARCHELAUS, a Greek philosopher, who flourished about 440 years before the Christian era. He was the last teacher of the original Ionic school, which he removed to Athens, acquired great celebrity, and was the master of Socrates. He taught that a double principle exists in all things, namely, the *expansion* and *condensation* of the air; that heat is ever in motion, and is the cause of action, and that cold is always at rest. He ascribed infinity to the universe, supposed that the earth, originally a chaotic mass of moist matter, assumed, when dried, an ovate form, and asserted that all living creatures were produced from its heat. In morality, it is said, he maintained that nature had made no distinction between right and wrong, that all actions are indifferent in themselves, and the character of good or evil is marked only by positive institutions.

ARCHERY is the art of shooting with a bow and arrow. The origin of this art is undoubtedly coeval with the earliest period of the history of most nations. It is particularly mentioned in Sacred history; and the Persians, the Ethiopians, the Egyptians, and Scythians, but especially the latter people, were celebrated for the practice of archery. Among the Greeks the bow was early employed as an implement of war; and the Romans, in a later period of their history, successfully adopted the same instrument. The Goths, the Vandals, and the Huns, were in no small degree indebted to the use of the bow and arrow for their rapid progress and victorious career.

The use of the bow, it is supposed, was unknown in Britain till about the period of the Saxon invasion. But in England archery afterwards attained a high degree of perfection. The famous battles of Cressy, Poictiers, and Agincourt, were won by the skill and prowess of the English archers. The English government liberally encouraged archery, and numerous statutes, some of which were passed even after the introduction of fire-arms, were enacted for the regulation of the practice; and it is curious to observe that, as late as the time of Elizabeth, and even later, treatises were published in which the bow is preferred to the musket as a military instrument.

Archery was not neglected in Scotland. An act of James I. required all males to practise the art; but it is generally admitted that the Scots were inferior to their southern neighbours in the use of the bow. The battles of Homildon and Flodden, so fatal to Scotland, were decided in favour of the English by the strength and skill of their archers.

Archery is now known in Britain only as an active and agreeable amusement. Three associations exist in England for its practice, under the name of *The Kentish Bowmen; The Woodmen of Arden;* and *The Toxophilites.* In Scotland two societies are instituted for the same purpose: *The Royal Company of Archers*, at Edinburgh, which is supposed to date its origin in the time of James I., was incorporated by a charter from Queen Anne; and *The Kilwinning Society of Archers* has long held an annual meeting, which is well known in Ayrshire by the name of Papingoe. Some of the members of these societies possess considerable dexterity and skill in the use of the bow and arrow.

ARCHETYPE is the first model of a work according to which others are constructed. In the language of the mint, the same term is applied to the standard weight by which others are adjusted.

ARCHÆUS, signifying *principal, chief, or first mover*, is a term applied, by Van Helmont, to an imaginary being which he supposed presided over the animal economy for its preservation. The place assigned for the residence of the Archæus was the entrance into the stomach.

ARCHIL, a colouring substance which is procured from certain species of lichen, and especially lichen *rocella* and *parellus*, which are brought from the Canary and Cape de Verd Islands. The colour is a rich purple; and in its preparation it is bruised, moistened with urine mixed with quicklime, and having undergone fermentation, is dried and formed into a hard paste. In this state it is called *litmus*. Archil is employed by dyers to heighten their colours, and the litmus is used as a chemical test.

ARCHIMANDRITE, in the ancient Christian church, seems to have been nearly synonymous with abbot.

ARCHIMEDES, one of the most celebrated of the ancient philosophers for his attainments in mathematics and mechanical science, was a native of Syracuse, and was born about 280 years before the Christian era. He began early to devote himself to his favourite pursuits, travelled to Egypt to improve and extend his knowledge, and even, it is said, by the power and vigour of his genius, reflected lustre on the bright day of learning which then illuminated the regions of the east. Returning to his own country, he resumed the prosecution of those profound investigations of which the fragments are sufficient to render his name immortal.

The close of the life of Archimedes is almost the only event which the scanty biography of the philosopher can commemorate, and this too, had it been less connected with public transactions, might have been wholly obliterated from human records. In a war between Hiero, king of Syracuse, and the Romans, Syracuse was closely besieged; and by the inventions of Archimedes, the accounts of which are probably exaggerated, when it is said that he set the ships of the enemy on fire by means of reflectors, and, when they approached nearer, dragged them out of the water by engines, the most vigorous efforts of the Roman power were long frustrated; but the city was taken by storm, and Archimedes, intent on a geometrical investigation, and ignorant of what had happened, was put to death by a soldier; although it is reported that Marcellus, the Roman general, had issued strict orders to save the philosopher and to protect his house from plunder. Marcellus was deeply grieved at his disastrous fate; and, as an act of retribution, conferred signal favours on the relatives of Archimedes, honoured his memory with a splendid funeral, and ordered a tomb to be erected, on which, as the philosopher had desired, a sphere inscribed in a cylinder, alluding to his beautiful discovery, was sculptured. The death of Archimedes happened 212 years before the Christian era. After the lapse of 140 years, Cicero visited the tomb of the Syracusan philosopher. No memorial of it then remained in the minds of his countrymen; but, after a diligent search, the top of a column rising from a close thicket of thorns and briars was discovered; and the sphere and cylinder, which time had spared, marked it as the tomb of Archimedes.

The discovery of the method of determining the specific gravity of bodies, which, it is said, he made while bathing, is ascribed to Archimedes; his knowledge of the power of the lever is illustrated by the famous apophthegm, " Give me a place to rest upon and I shall move the earth;" and the screw for raising water, which is distinguished by his name, the spiral screw, the system of pulleys, and various compound machines for raising weights, are enumerated among his inventions. The works of Archimedes yet extant, are, " On the Sphere and Cylinder;" " On the Dimension of the Circle;" " On Conoids and Spheroids;" " On Spiral Lines;" " On the Quadrature of the Parabola;" " On Floating Bodies," &c. A splendid edition of his works was published at Oxford in 1792.

ARCHIPELAGO, a general appellation for a sea interrupted with islands, was originally limited to the Ægean sea between Asia and Europe, but is now extended to any sea divided or broken by numerous islands.

ARCHITECTURE.

Architecture, or, the Art of Building, is divided into three branches, denominated from the purposes to which they are respectively applied—Civil, Military, and Naval. It is the first only, which is usually, for the sake of distinction, called Architecture, that is to be the subject of this treatise. Our view of it will comprehend its most general principles, considered both as a mechanical science and a fine art. We propose, accordingly, to speak,

I. Of the Materials used in Architecture. II. Of the Principles of Construction. III. Of Style, or the Production of Effect. And we shall conclude with a short history of its origin and progress.

Architecture

PART I. OF MATERIALS.

In treating of the materials which are usually employed for architectural purposes, two things are to be considered,—1. The kinds and qualities of materials; and, 2dly, Their mechanical strength.

Chap. I. Of the Kinds and Qualities of Materials.

Materials may be divided into Constructive, Uniting, and Ornamental.

SECT. I. *Of Constructive Materials.*

Constructive materials are timber, stone, brick, earth including clay and turf, slates, tiles, thatch, &c. some of the metals, and glass.

Timber.—Trees, even in their rudest state, or with little alteration, are convertible into defences against the weather and the attacks of wild beasts. The early inhabitants of some countries used no other materials. But it is not this primitive architecture that we are to contemplate. The term *timber* is applied to such trees as admit of being cut into planks and posts, in which condition chiefly they are employed in modern times and civilized countries.

Different trees have different natures, and timber, consequently, is of various qualities. Those principally required are magnitude, cohesion of fibres, the capacity of being wrought, and durability. That timber which has these qualities in greatest perfection, is of course most valuable. In general, the gifts and advantages of nature being in some degree qualified, it is necessary to compound between them; and the consideration of expense, dependent on the plenty or scarcity of the kinds of timber, is an important matter in the builder's calculation. We may notice a few particulars respecting certain species used in this country.

Fir is plentiful, may be had of great magnitude, and is easily wrought. Oak surpasses it in absolute strength and durability, but is dearer, and demands more labour. Beech is a close compact wood, soon injured by moisture. Ash affords a neat, tough, and conveniently worked timber, but does not stand the weather well. The chief excellence of elm is its bearing to be pierced or bored with nails and bolts, better, perhaps, than any other wood, but it is extremely liable to shrink and warp, and is very cross-grained, so that it cannot safely be trusted. Spanish chesnut has some of the characters of oak. Lime, sycamore, and poplar, partake of the imperfections of beech. Memel fir is, perhaps, on the whole, the most eligible timber for the ordinary purposes of builders.

Stone.—This is the general name for all the earthy minerals employed in building, such as sandstone, granite, porphyry, whin, lime-stone or marble, flint, &c. These also have different qualities, and are consequently of greater or less value.

Sand-stone.—Sand-stone is usually found in flat pieces, of variable but seldom very great thickness, so that it needs only to be cut transversely, in order to afford suitable sizes and shapes. This is easily done when it is soft, but excess of softness is obviously an essential fault. The contrary extreme is rarely met with in sand-stone, and can scarcely be objected to when it is, unless where labour is very dear. The upper beds of the quarry are generally softest, and the hardness increases rapidly with the depth. To this remark, however, there are many exceptions. Some sand-stone becomes hard by exposure to the atmosphere, as that found near Bath. The abundance of good sand-stone in its vicinity, has contributed to the beauty of New Edinburgh. That procured at Craig-Leith quarry, a little to the north-west of the town, has been long famed, and is in demand at London, Gottenburgh, and other distant places.

Granite.—When the constituent parts of granite are pretty uniformly mixed, it is much esteemed for building purposes. It generally possesses very great strength, is found in very large masses, and has often a pleasing variety of colour, but with rather too much of a sparkling appearance. The town of Aberdeen is built of a granite, some of which has lately been introduced into London for its strength and durability, so requisite in some parts of bridge building.

Porphyry.—Porphyry is often confounded with granite. The name applies to a vast variety of stones occasionally used. Whin, or greenstone, a very abundant production in many countries, is extremely durable, and may be readily dressed with the hammer. It is employed for coarse walls and inside work, being commonly too dark for shew; in Scotland, where it is very plentiful, the roads and streets are paved with it. Clinkstone, basalt, and some other stones, found in similar situations, may be ranked with whin.

Limestone—has very diversified appearances and qualities. When it is hard, as in the marble of some countries, and when the conversion of it into lime is not thought to be of greater moment, it is employed in building. It dresses well, and is easily divided.

Flint,—or siliceous stone, is commonly so hard and so difficult of receiving form, that it is rarely used in this art on the large scale. But small flints may be advantageously had recourse to in some cases. The method of using them, recommended in Mr Atkinson's Views of Cottages, &c. deserves notice. It is very similar to the process of raising Pisa walls.

Objection to stone.—An important objection to many sorts of stone is their great power of conducting heat. It is most remarkable in those that are very dense and compact, as whinstone. In consequence of it, plaster does not adhere well to them, and they have a cold, raw, or moist feel. The vulgar notion is, that these stones contain water, which they give out in peculiar conditions of the weather; but the fact is to be explained on a chemical principle, viz. the abstraction of heat from the adjoining air occasioning a deposition of the vapour that had been dissolved in it. The condensation of moisture on the windows of a crowded room during cold weather, is a phenomenon of a similar nature. The best remedy, perhaps, or rather defence against the evil, consists in separating the lathing from the walls for some distance, and filling up the intervals with some bad conductor, such as dry earth, sand, brick-dust. There are few cases in which this practice would not be found highly conducive to comfort.

Roasting the stones, which some have proposed, even if any way consistent with time and economy, will not alter their nature, unless carried to a very high degree, and therefore cannot be generally recommended.

Bricks.—In many respects this is a better material than stone; and the objection which has sometimes been made to it, namely, its want of durability, applies rather to the particular manufacture than to the substance itself. Bricks may be made to vie with stone in this very quality, and even claim the preference which an Egyptian monarch, spoken of by Herodotus, seems to have given them. "This prince," says that historian, "desirous of surpassing all his predecessors, left, as a monument of his fame, a pyramid of brick, with this inscription on a piece of marble: "Do not disparage my worth by comparing me to those pyramids composed of stone; I am as much superior to them as Jove is to the rest of the deities; I am formed of bricks, which were made of mud, adhering to poles, drawn from the bottom of the lake." Beloe's *Herod. Euterpe*, 136. This very pyramid, noticed both by Norden and Pococke, is situate about four leagues from Cairo. It is the only one that is built of these substances, which are understood to have been sun-dried; but it bids fair to last as long as any of those wonderful fabrics.

In this climate, probably, we have not sun enough to convert clay into bricks within a reasonable time. Artificial heat is, accordingly, almost constantly applied to it. This renders the material costly, especially where coal or other fuel is scarce. Bricks are much more easily arranged, occupy less space, and are lighter for carriage than stones, but are liable to several imperfections, arising from the inadvertencies and mismanagement of workmen.

Earth, &c.—Earth, including clay and turf, is now seldom ranked amongst constructive materials, where the science is well established. They are occasionally used, however, especially in country places, and are the rather noticed here, because we wished for an opportunity of stating some useful remarks of Mr Atkinson's on the construction of mud-walls for cottages. These when well made are very durable. The skeleton of the cottage, which is first formed, consists of upright pieces of timber, about four inches square, placed at the distance of 15 inches from each other, and bound together by horizontal pieces for the support of the roof and floors. Strong plastering laths are then nailed horizontally across the upright pieces, on which the mud or plaster properly mixed with chopped straw, is to be laid with a trowel. When this has become dry, a thin outside covering of lime and sand is to be applied over it; and the inside of the building, which is to be lathed in the same manner, may be covered with mud, or with lime and hair. Those mud walls are said to be best which are composed of clay and a large portion of sand in rather a coarse state.

Pisa walls.—Here, too, we may describe the nature of Pisa walls, so called because much used in the city of that name. The foundation is either of brick or stone raised about two feet from the ground. On this is fastened, by means of wedges, a sort of wooden case, containing the common earth of the fields, very hard pressed down. This case is moved always upwards as the work proceeds, and the wall when dry, is covered with lime and sand. It is a a process like this that is recommended by Mr Atkinson from small flints, as formerly mentioned. These, as existing in gravel, and combined with mortar, are used in place of the earth put into the frame. It is convenient to know the practibility and efficiency of such means, as cases may occur to require their adoption.

Slate, Tile, &c.—These materials are confined to the construction of the roofs of houses, of which they form that part which is exposed to the weather. They are not all equally suitable to the purpose, but the selection is generally determined by local circumstances and prejudices.

Metals and Glass.—Lead and copper, besides occasional uses in building, are sometimes substituted for the substances now mentioned, as roofing materials. Iron is still more extensively employed, and every day discovers additional proofs of its subserviency to the purposes of the builder. In carpentry, an important branch of architecture, it has been long applied to the offices of king and queen posts, straps, &c. for roofs. Modern artists have introduced it into the construction of windows, stairs, floors, &c. with decided advantages where great strength is required, and especially where there is unusual hazard of fire. The finest examples of its value, as a constructive material, is to be seen in cast iron bridges, those splendid monuments of modern ingenuity.

Glass is entirely confined to the structure of windows for the admission of light. It is of various qualities and denominations, as plate-glass, crown-glass, German glass, &c. In some countries, where the manufacture of glass is unknown, or where it cannot conveniently be procured, a substitute for it has been found in talc, mica, some sorts of shells, &c. &c. no way, however, comparable to it in properties.

Sect. II. *Uniting Materials.*

The terms *Cement*, *Mortar*, *Tarras*, in masonry, are often used synonymously. But it would be convenient to restrict each to a distinct composition, viz. the first to such uniting materials as are employed in a liquid state,—the second to the merely soft mixtures of similar ingredients—and the last to those of a still more compound nature, used in aquatic buildings. As we cannot reasonably, however, expect to modify the current language, we must of necessity continue to speak as others have done before us.

Nature of mortar.—The chief and essential ingredient in cement is lime, not, indeed, in its natural state, but after having undergone the process of burning. So long as limestone contains fixed air or carbonic acid, it is unfit for cement; and, all other circumstances being alike, that lime which has been most effectually submitted to the action of fire, by which the fixed air is driven off from it, is most serviceable for the purpose. Now, as it is proved by experiment, that lime, after this treatment, gradually re-combines with fixed air if exposed to the atmosphere, an obvious precaution is suggested, viz. that of preserving it covered with sand or earth, &c. when not immediately in use; and on the same principle, it cannot be too powerfully inculcated on those concerned, that the sooner they use lime after it is burnt, the greater is the chance of its obtaining its advantages. The inattention of workmen to this important fact, is often so gross as to justify the strongest censure, because the infallible consequence is the speedy destruction of the building. To them, perhaps, it is quite unimportant whether the stones be cemented or not, provided they have laid in a sufficient quantity of what is supposed to answer the design. But the owner is certainly interested to have a durable fabric, and a conscientious artificer will study something else than the mere appearance of his materials.

It can hardly be said that the ancients had better ingredients for the composition of their cements, and yet it seems certain that their buildings bid fairer for prolonged existence, even commencing with the present time, than the generality of those which are now erected. Or if it be admitted that they had, still we must confess that they derived their superiority chiefly from their greater circumspection and industry. Here we cannot refrain from availing ourselves of the words of an experienced observer, who has done so much for the improvement of the arts of building in this country; we allude to Mr Peter Nicholson, from whose Architectural Dictionary we quote the following passage: "The practice of our modern builders is to spare their labour, and to increase the quantity of materials they produce, without any regard to its goodness; the badness of our modern mortar is to be attributed both to the faulty nature of the materials, and to the slovenly and hasty methods of using it. This is remarkably instanced in London, where the lime employed is chalk lime, indifferently burnt, conveyed from Essex or Kent, a distance of ten or twenty miles, then kept many days without any precaution to prevent the access of external air. Now, in the course of this time, it has absorbed so much carbonic acid as nearly to lose its cementing properties; and though chalk-lime is equally good with the hardest limestone, when thoroughly burned, yet, by this treatment, when it is slaked, it falls into a thin powder, and the core, or unburned lumps, are ground down, and mixed up in the mortar, and not rejected as it ought to be. The sand is equally defective, consisting of small globular grains, containing a large proportion of clay, which prevents it from drying and attaining the necessary degree of hardness. These materials being compounded in the most hasty manner, and beat up with water in this imperfect state, cannot fail of producing a crumbling and bad mortar; and, to complete the miserable composition, screened rubbish, and the scraping of roads, are thrown in as substitutes for pure sand. How very different was the practice of the Romans! The lime which they employed was perfectly burnt, the sand sharp, clean and large grained; when these ingredients were mixed in due proportion with a small quantity of water, the mass was put into a wooden mortar, and beaten with a heavy wooden or iron pestle, till the composition adhered to the mortar; being thus far prepared, they kept it till it was at least three years old. The beating of mortar is of the utmost consequence to its durability, and it would appear that the effect produced by it is owing to something more than a mere mechanical mixture."

In Scotland, generally speaking, there can be no excuse for the rapidity with which walls moulder down. We have lime of excellent quality, the mode of burning it is thoroughly understood and generally well practised, and sand and pebbles of all sorts may commonly be had at little expence. We shall not, then, be thought either disposed to cavil, if we assert that there is a blameable inattention to several important particulars, or officious, by taking it upon us to suggest the necessity and benefit of greater caution. Attention to the following directions, we have no doubt, will insure durability and firmness.

Directions for its preparation.—In the first place, let the lime, whatever be its quality, whether common limestone, chalk, or marble, be sufficiently burnt. This it is the interest as well as the duty of the builder to see into, and he is not warranted in committing the fact to the assertions of the people of the kiln whence it comes, or to the notions of his own subordinate agents. Secondly, let it be as soon as possible put into use, or, at least, covered from the air till it is so. If it is to be brought from a distance, it ought to be conveyed in close carts; waggons, or proper vessels, or, at all events, be furnished with some screen, as matting, straw, &c. not in shallow, wide, and unsheltered vehicles, nor late on *Saturdays*, when it will almost infallibly be left unprotected for at least thirty hours. Thirdly, Having immediately slaked it, let the proper proportion of clean large grained sand be mixed with it, adding no more water than is barely necessary for working it, which is to be done as already mentioned. And here we ought to say a word or two about the quality and proportion of sand to be used. That which is large and sharp, so as to prick the hands when rubbed, having no earth or mud mixed with it, which can be easily discovered by washing some of it in water for a trial, is to be preferred. Fossil-sand dries sooner than what is taken from rivers, and is fitter therefore for outside work, where it is of consequence to effect a speedy consolidation; but it is apt, if long exposed to the air before being used, to become somewhat earthy, which is alway a fault. A white sand is generally very smooth, and consequently not good; for the same reason, sea-sand, which has been subjected to a rolling motion, and is of course smooth, is not eligible. The proportion of sand must be varied according to the precise object in view; sometimes, three parts to two of lime; at others, equal parts of each; whilst, according to Vitruvius, three parts of pit-sand and two of river-sand may be used with one of lime. Wherever this last proportion can be adopted, it is obvious that the quality of the lime is greatly confided in. Lastly, let the mortar be kept well covered up for some considerable time before being laid on; and before using it, have it thoroughly beaten over again.

Improved Mortar.—Considerable attention has been paid of late years to the improvement of cements; and, in consequence, several very useful processes have been discovered The addition of bone-ashes, wood-ashes or charcoal, cellular or compact basalt in the state of powder, lime itself in the state of powder, and a great variety of other substances, to certain proportions of the other ingredients, is ascertained to promote their cementing power. What is called Loriot-mortar, from a Frenchman who discovered it, is of much efficacy. It consists in the addition of one-fourth or one-sixth part of powdered quicklime to the common mortar, only prepared a little thinner than usual. This compound, a few minutes after being made, acquires the consistence of plaster of Paris, and in a few days becomes as dry as ordinary mortar at the end of some months. As a water-cement, which requires speedy drying and firming, this mortar is extremely valuable. The tarras, or trass mortar of the Dutch, long used by them for the mounds and other works by which they have succeeded in protecting their low lands from the inroads of the ocean, is no way inferior to this composition. It is made by mixing the substance called *wakke*, or cellular basalt, reduced by grinding to the state of coarse sand, with the blue argillaceous lime that is got on the banks of the Scheldt. The process is quite a simple one. As much quicklime as will be needed in a week is spread in a kind of bason, to the thickness of about a foot, and sprinkled with water; then a stratum of tarras, such as above described, is laid over it to the same depth, and allowed to remain for two or three days, when the whole is beaten and mixed together, and again left for as long a time. It is now fit for building, and only requires to be well beaten when about to be used. The tarras has been imported from Holland into Britain for the sake of its efficacy. But this is expensive, and perhaps not altogether indispensable, as, according to Mr Nicholson, common basalt, provided it be calcined, will answer the purpose. This gentleman specifies the Calton-hill at Edinburgh as chiefly consisting of cellular basalt, to which, on the whole, he gives the preference, perhaps as not requiring the expensive employment of fuel for preparing it. "This hill," he says, "being but a short distance from the port of Leith, offers an inexhaustible abundance, at a small cost." We do not think this hint has ever been taken advantage of, as it might have been, especially since the great undertakings lately commenced on that hill have afforded an important opportunity. On the contrary, we have reason to believe, that the substance to which Mr Nicholson alludes, and which has been dug up, or blown, in large quantities, has been cast off as mere rubbish, for the filling up of vacancies. It may not be amiss to take notice here of a traditionary report, regarding an offer once made to the Magistrates of Edinburgh by some merchants from Holland, viz. to remove that hill free of expence. The common notion was, that they believed it to contain gold; probably they had remarked its abounding in a substance of greater real value.

Puzzolana.—A peculiar earth, found at Puteoli, in the bay of Baiæ, in Italy, from which circumstance it has often got the name of "powder of Puteoli," "Puteolian earth," and, corruptly, *puzzolana*, was used with great efficacy by the Romans as an addition to mortar, much in the way we have already described. As this earth is a sort of ferruginous clay, that seems to have been calcined by volcanic fire, there is every reason to believe, that similar minerals, subjected to the agency of heat, and then treated in a like way, will be found no less efficacious. All that is necessary is, that after burning, and in some cases this may be dispensed with, the substance be pounded down to a coarse powder, and then beaten up with lime, either with or without sand, in the manner already mentioned. This compound quickly sets under water, and acquires a degree of strength not inferior to that of many stones. Forge scales, brick and tile powder, coal-cinders, and a great variety of other substances, may be substituted for puzzolana, with perhaps equal benefit. The mortar-mill, a machine contrived by Mr Supple, facilitates the reduction of such substances. In some cases, where the utmost durability is needed, a certain quantity of bullocks blood, skimmed milk, or other glutinous fluid, is added to the water.

Glue,—is a substance of a viscid nature, prepared from the skins of animals by a particular process, and is used as a cement for wood chiefly.

The substances denominated *solder* and *putty*, belong to plumbery and glazing.

Sect. III. *Ornamental Materials.*

With regard to ornamental materials, most of the substances enumerated might here be reconsidered, as, in fact, almost every thing on which human ingenuity can be exercised, is capable of conducing to pleasing effect. But what we now allude to under this title, are those substances, which, whether essentially useful or not in the construction of buildings, are more commonly valued on account of their use as decorations. There are many substances of this kind, such as the *pigments*, or colouring matters; *stucco;* those used in mosaic work; certain *metallic* bodies applied to the locks and handles of doors; *paper* for covering the walls; *marble* for statues, slabs, and chimney-pieces. It is enough to have merely mentioned them here; and the reader will at once perceive, that the plan of this publication allots more suitable occasions for further notice.

Chap. II. Of the Strength of Materials.

Some materials are stronger than others, that is, bear greater force, or resist it more effectually, though perhaps of the same shape and size, and placed in like circumstances. The cases in which such comparisons have been made are so numerous, that one might imagine we ought, in this age of the world, to have been put into possession of an immense mass of information, highly valuable to the practitioner, and sufficient for the basis of an accurate science. But we shall err egregiously if we take the opportunity of acquiring information on any subject as the measure of the quantity acquired. We may lament, but we can be at no loss to account for the fact, that it is only of late years this subject has received the slightest elucidation in any of the elementary books which are the professed guides of our operative men. It is to the carpenter that it is chiefly interesting; and, fortunately for him, most of the experiments and observations have been made on the materials of his art. We shall state the most important results, premising some general remarks.

The heart of most, perhaps of all trees, is weaker than the outer parts, with the exception of that portion which is next to the bark, usually called the white or blea. The wood that is in the middle of the trunk is stronger than that at the origin of the branches, or at the root; and that of the branches themselves is weaker than that of the trunk. The wood that is on the south side of trees, (those of Europe at least,) is stronger than that of the north side. The heart of a tree is always nearer to the north side, which may account for this peculiarity. Timber is most tenacious whilst green, and loses of its strength in drying. From these remarks, it is evident, that different slips of the same timber may differ considerably in strength, and hence a vast number of experiments becomes necessary to afford even a few elementary propositions.

The strength of beams, as of all other materials used in building, depends on the cohesive and repulsive forces of the particles composing them, and these forces are variously called into action, according to the nature of the strain. Thus in the case of tension, that is, when a body is stretched, the form is retained by cohesion; in the case of compression, it is the repulsive force that is first engaged in resistance, though the cohesive force afterwards operates in preventing the particles or fibres of the body from sliding sideways on one another; whilst, in the third strain, called transverse, both these forces seem to be exerted at the same time, only in different parts of the body. We proceed to consider these strains more particularly.

Sect. I. *Of Transverse Strains.*

The strength of beams against transverse strains has been estimated by the weights which they can bear, or which are necessary to break them when they are fixed at one end, or at both ends. The most general theorem on the subject, for which we are indebted to Galileo, though in some degree hypothetical, is a very useful approximation to the truth. It may be thus stated:

The weight required to break a beam, having one of its ends firmly fixed in a wall, is proportional to the strength of its fibres, multiplied into the area of its section, and into the distance of the centre of gravity of this section from the point round which the beam turns in breaking, divided by its length. The weight is supposed to be applied to the free end of the beam; and the strength of the fibres is estimated laterally. It is nearly proportional to the specific gravity of a given bulk of the timber.

The strength of a beam having a rectangular section, all other things remaining the same, is very nearly as the square of the depth multiplied into the breadth. This is the result of some of Buffon's experiments. The real strength is rather less than this proposition makes it, and the more so the longer the beam is. But the exact amount of the decrease has not been hitherto ascertained, and probably will not, till the nature of the influence which the length of timber has on its strength be fully understood. Dr Robison, late professor of Natural Philosophy in the University of Edinburgh, proposed something like a solution of this question, but was candid enough to admit, that it did not merit implicit credit. According to him, a beam of quadruple length, instead of having one-fourth of the strength, as the rule states, has only about one-sixth part.

The strength of beams having the same length and breadth, being as the square of their depths, it follows, that the strongest beam that can be cut out of a given cylindrical tree, is that in which the breadth is to the depth as one to the square root of two; hence the strongest beam is not that which has the greatest quantity of timber, as will be seen when we mention a problem belonging to this subject.

The strongest form of a beam, however, of given length and weight, differs in different circumstances. In general, it ought to be thickest at the part most firmly fixed. Even the position in which it is placed, with respect to its own form, has an important effect on its strength. This is remarkable in the case of a beam having a triangular section. Its strength, for example, is no less than twice as great when one of its faces is uppermost, as when it is reversed. Similar to this is the very remarkable difference observed between the strengths of cylindrical beams and tubes, having the same quantity of matter. The latter, it is well known, are much stronger. Nay, there is still a more singular case, which it may be right to mention, though likely to stagger the faith of most readers. A tube of metal is said to support a greater transverse strain, than a solid cylinder having the same diameter; or a solid cylinder is strengthened against this strain, by being bored in the direction of its axis, and having a considerable portion of its substance removed. Mr Playfair has given a probable explanation of this paradoxical phenomenon, in his Outlines of Natural Philosophy.

The force necessary to break a beam transversely, is, very probably, to its force of cohesion, as the depth to from six to nine times the length; but cannot be in a greater ratio than as the depth to twice the length.

A beam supported at both ends, and having the same section throughout its length, is weakest in the middle; but it will bear there twice as much as either half firmly fixed would bear at the other end, or as it is able to bear when supported only at one end. This will be readily understood, by supposing it to be inverted, and to rest on a fulcrum in the middle; for the fulcrum will bear the sum of the equal weights at the ends, and the beam will bear a weight on its middle equal to its pressure on the fulcrum. If each end of the beam be firmly fixed, instead of being merely supported, its strength will be doubled, the circumstance of the ends being prevented from rising, adding a force capable of supporting the whole of the weight which the beam could originally support.

The weight which a beam, firmly fixed at one end, and projecting with a certain inclination to the horizon, will sustain, is greater than what it will support if projecting without any inclination, that is, if horizontal, in the ratio of the square of the radius to the square of the cosine of the angle of inclination. For the resistance of the beam is increased by the centre of gravity of the section being removed farther from the fulcrum; and the momentum of the weight again is lessened in the oblique position of the beam, by its perpendicular distance from the fulcrum being diminished; now these being each in the inverse proportion of the cosine of the angle of incli-

Materials.

nation, their combined effect is in the proportion of its square. Hence the great advantage of making the strain on timber as oblique as possible.

As the strength of beams decreases at least in the proportion of the square of the length, and the weight increases as the cube, it is evident that there is a limit, which, if a beam of a given shape, and of given materials were to reach, it could only bear its own weight. This, therefore, often requires to be considered. The usual way is to suppose the weight of the beam to be an addition to its load collected in its centre of gravity, and to allow for it accordingly. The length of time to which beams are subjected to a transverse strain, requires also to be considered. When a beam, therefore, has to sustain its own weight, as it does when placed parallel to the horizon, and is to be left long in this state, we ought not to put above a third or a fourth part of the additional weight on it that it is at first able to sustain.

Two thirds of the weight that is sufficient to break a beam when first laid on it, will sensibly impair its strength, and at the distance of some time, perhaps two or three months, will cause it to give way. One half of the weight produces a certain degree of curvature, which, however, will remain stationary for any length of time. One third of the weight will scarcely produce any permanent effect on the beam, which will recover its shape perfectly after having been so loaded for many months. One fourth part of the weight may be borne for ever, without producing the slightest set.

We subjoin to this part of the subject the following problem, which is of continual use in the practice of carpentry.

Prob. To cut the strongest possible beam out of a tree, the section of which is a given circle.

Let A E B F, Fig. 1. Plate 11. be the given section. Draw the diameter AB, divide it into three equal parts, viz. at d and e. From d or e draw a line perpendicular to the diameter, and cutting the circumference, as the line e E. Draw A E and E B. Complete the right-line figure A E B F, by making A F parallel to E B and B F to A E, both of them cutting the circle at F. This will give the section of the strongest beam that it is possible to cut out of the tree; for the square of the depth A E or B F multiplied by the breadth E B or F A is the greatest that can be produced, as might be demonstrated mathematically. Now, as the greatest rectangle that can be inscribed in a circle is a square, and as the section A E B F is not a square, it is evident that the strongest beam does not contain the most timber. To this we add an important result from some experiments of M. Buffon, founded on the fibrous or plated texture of timber, as made up of annual circular additions, the cohesion of which with each other is much less than that which exists between their own fibres. Let Fig. 2. Plate 11. represent the section of a tree, from which two quarterings as they are called are to be cut. Let A D and a d be the depths, D C and d c the breadths. The quartering A B C D will be stronger than a b c d, in the proportion where oak is employed, of 8 to 7. This, in certain cases, would be of material consequence, and will of course affect the results of experiments not instituted with attention to the fact. It seems to be on the same principle, that a number of planks set edgeways will be stronger than if laid one above another.

Materials.

Sect. II. *Of Tension.*

We have now to speak of that strain by which timber is drawn asunder, and which is intimately connected with its absolute strength, or the cohesion of its fibres.

Few experiments have been made on this subject that lead to practical purposes. Those of Muschenbroak, for example, were performed on small slips of timber, and, even admitting their accuracy, cannot with much propriety be held as authority for the case of large beams. It is desirable to prove the application by some on a greater scale; but this, from the difficulty and expense attendant on it, will not probably be soon executed. The fundamental principles in this particular case may be briefly stated.

The cohesion, or absolute strength of a fibre, is that force by which every part of it is held together, and is equal to the force which is required to pull it asunder. Supposing the texture of the body, therefore, to be uniform, and that consequently every particle or fibre has the same cohesion, it is evident that the whole cohesion must be proportional to the number of the fibres. The absolute strength or cohesion, therefore, in any part of a body, and the force which is requisite to tear it asunder in that part, are proportional to the section of the area, perpendicular to the direction of the extending force. It follows, that all bodies of the same texture, and presenting the same area of section thus taken, are equally strong in every part, and will therefore break alike in every part. And on the other hand, bodies having unequal sections, will break where the section is the least. The length of the bodies is immaterial in this case, and hence a long rope, or other cylindrical body, is neither weaker (as is commonly imagined,) nor stronger than a short one, in all other respects alike. But here also it may be noticed, a body may be so long as to break by its own weight. When hanging perpendicularly, it does so towards the upper end, although equally strong, the strain on that part being, in this case, equal to the weight of the whole that is below it: and hence we say, that the power of any part to resist the strain thus applied to it, is inversely as the quantity below it. In the case of the body being stretched horizontally, the strain arising from its own weight, as we have already seen, bears a sensible proportion to its entire strength; it must then be taken into account where an extending force is also at work. A flexible body, as a rope or chain, whatever be its strength, may therefore be extended so far, that is, be so long, that its own weight will break it; and hence the absurdity of a proposal that has sometimes been made, to construct a bridge of chains over a wide space.

Two-thirds of the weights requisite to tear bodies asunder will sensibly impair their strength, if long attached to them; and one-half is the utmost that can be perpetually attached to them without risk of injury. Those bodies which have the straightest fibres are best adapted for sustaining tension.

Sect. III. *Of Compression.*

We have now to consider a case apparently the opposite of the preceding, that of compression, one of still greater difficulty, and in which, notwithstanding its extreme importance, less has been ascertained in the way of scientific principle.

At first sight it appears difficult to conceive how the compression of a perfectly straight piece of timber should have the effect of breaking it. The tendency of the force applied at the extremes, seems rather to favour the cohesion of the parts of the body, and might be expected, therefore, to increase, not to lessen its strength. On the supposition, indeed, of any obliquity in the direction of this force, it is easy to understand how certain parts may slip on each other, and, consequently, the beam be fractured. Nor is it difficult to perceive how a force, acting on the beam in a direction perpendicular to that in which the compressing force acts, should produce a certain degree of curvature, and hence allow the approach, if we may use the expression, of the compressed extremes, that is, contribute to the fracture. But on the supposition that the particles of a column are perfectly hard, and in contact, and, at the same time, that the fibres are all arranged in the direction of the pressure, it seems impossible to conceive how they can be disunited by it. But this supposition is a very arbitrary one. Whether there are such bodies, may well be doubted; or whether, if there were, they would be totally indestructible and inseparable by compression, it might be difficult, if not impossible, to determine. We must content ourselves with the consideration of such as are commonly met with, and are usually employed in building.

Timber, beyond all doubt, does not answer these conditions. Neither are its particles perfectly hard, nor are its fibres uniformly in the direction of a compressing force. On both accounts, therefore, it may be expected to yield, and of this we have infallible proofs. It is very evident that the effect of the pressure will be to increase the curvature of the fibres, and, therefore, that, at last, by augmenting the weight, the fibres will give way, and the beam be broken.

The peculiar nature of the wood, it is easily to be understood from what has been said, will materially influence the effect now stated to take place. A very soft wood is easily compressed. This may happen either from the particles being at considerable distances from one another, or because their fibres are very much incurvated. But some hard timbers, owing, it is probable, to this last circumstance, are less capable of resisting compression than others which are of a softer nature. Oak, for example, though it will endure tension better than fir, does not carry so great a weight. The proportion has been rated as high as two to one in favour of the latter. But this, perhaps, is too high. The artist, however, will attend to the difference, and accordingly employ these two species of wood for different purposes. The disproportion between the powers of some bodies, in this respect, is immense. Glass, for instance, is said to be able to bear a hundred times the weight that oak will do, though it will not suspend above four or five times as much.

It would be convenient to know the various powers of different substances, as to this particular. Judicious experiments are required to determine them; few have hitherto been instituted on which we can rely. A very hard freestone, whose section was a square foot, was found to bear 664,000 pounds with perfect safety. Its highest strength was much greater, 871,000 pounds. Some inferior pieces did not bear more than 460,000. A soft freestone, of similar dimensions, bore from 187,000 to 311,000 pounds. The safe load for it was averaged at 249,000 pounds. This is inferior to the strength of good brick, which is said to carry 320,000. Chalk, a very soft substance, carries only 9000 pounds. Sound oak is supposed to require above 60 pounds on every square line to crush it.

The proportion between the strength of a body thus tried, and the area of the section which it presents, has not been ascertained. The theory of Euler, that the strength was as the biquadratic power of the diameters, is at variance with experiments. It is not proportional to the area, as has often been imagined, nor to any power or function of the area. In certain cases, there appears to exist a relation between the forces opposed to tension and compression, and not in others. In short, the whole subject requires elucidation.

When a beam or column is overloaded, it is observed to increase in diameter; it then cracks or shivers longitudinally, and at last gives way. The process is called *crippling*. It may occur in a variety of situations, as the compressing force is perpendicular to the horizon, parallel with it, or inclined at any angle. The length of the column has no effect on its strength, unless a transverse strain takes place; and this the carpenter guards against, by the use of what are called transverse bridles. The employment of hoops, metallic rings, ropes, &c. materially increases the strength of beams exposed to compressing force.

Sect. IV. *Of the Twist.*

There is still another kind of strain to which materials are sometimes subjected. It is the case of twist. This occurs principally in pieces of machinery, and especially in the axles employed to communicate motion. To the house-carpenter, this is comparatively unimportant, as he rarely has to expose his materials to such a trial. We shall merely remark respecting it, that the strength by which an axle or beam opposes twisting, or being wrenched, is generally proportioned to the cube of its diameter, and that the internal parts do not resist so powerfully as the external. Hollow tubes, therefore, have a greater superiority over solid cylinders, in resisting this kind of strain, than a transverse one. Many cases occur, in which both advantages may be obtained, and prove of immense consequence. Accordingly, engineers are now much in the practice of using hollow axles of cast iron, wherever the size will allow of the preference.

PART II. OF THE PRINCIPLES OF CONSTRUCTION.

The chief object of architecture, considered in a philosophical point of view, is to resist the causes of motion, or withstand the force of gravitation. The means of resistance are found in the various kinds of strength of the materials which it employs; and, generally speaking, there are three ways in which the object is accomplished, viz. support, suspension, and equilibrium. Every building exhibits at least one of these modes of effecting stability, and in many buildings we have examples of all the three combined. It is unnecessary, after what has been said in the preceding part, to occupy much room in treating of the two former, at least in a systematic manner. The last demands more of our attention, both because of its extreme importance, and as not having been so much as hinted at previously. There are some general laws, however, of an abstract nature, common to the whole, which we must first elucidate.

We shall treat, therefore, 1. Of the general principles of construction, including the third mode of resisting gravity, now alluded to; and, 2. Of some particular principles exemplified in certain productions of the art.

Chap. I. General Principles of Construction.

The chief proposition in the mechanical adjustment of materials, respects the composition and resolution of forces. It is of continual application in practice, and, together with the principles of the arch, which are afterwards to be considered, may be said to constitute the theoretical basis of architectural science. We shall study the convenience of general readers in our mode of explaining it.

Sect. I. *Composition and Resolution of Forces.*

If a body at A, Fig. 3. Plate 11. be acted upon at the same time by two forces; one in the direction of A B, and the other in that of A D, the intensities of which are proportional to these two lines, it will be affected in the same manner as if it were acted on by one force in the direction of A C, having an intensity proportional to that line, which is the diagonal of the parallelogram A B C D. If the forces acted in the directions of the lines A F and A G, or A K and AL, or AM and AN, and were respectively proportional to these lines, a similar effect would be produced, and the body would be operated on just as if only one force acted on it in the same direction A C, which is the diagonal of the three additional parallelograms represented by the dotted lines. A variety of parallelograms might be constructed, of which A C would be the diagonal; and there are as many combinations of forces, as may be conceived, which, acting on the body at A, would produce a similar effect. The slightest inspection of the figure will convince the reader, that as the directions of the forces approach nearer to each other, or are least distant from the diagonal, these forces most coalesce, or least oppose each other; and, on the contrary, that as the directions recede from each other, their opposing effect is the greater. If the directions, therefore, be the same, that is, both in the direction A C, the full effect produced is the simple addition of the effects of the two forces, that is, it is proportional to the line A C. On the other hand, if the directions be contrary, the effect will be that of the difference of the forces. In the former case, if the forces be equal, the body will be moved in the direction of the diagonal with a force which is double of that by which it would have been moved by one of them acting alone. In the latter case, if the forces be equal, the body will remain at rest.

The reader may amuse himself with observing the effects of combined forces on a moveable body, such as a ball to which two strings are attached. If the ball be laid on a horizontal surface, a table, for instance, it may be made to trace the same line by drawing the strings with both hands, at a variety of angles; and by a little practice he can vary also the intensity of either or both of the forces, so as to represent all that we have now mentioned. But he can more correctly perform these experiments by the help of small pulleys and weights, as is represented in fig. 4. This is easily explained.

The pulleys P and R, are fixed on a vertical surface, as a wall, or perpendicular board, so as to allow the easy motion of the cords, A P q, A R s, to which the weights q and s are suspended. At A is attached another cord, A T v, to which the weight v is suspended. These weights, acting separately, would draw the point A, in the directions A P, A R, A T. But if they all act at once, provided the weights q s, together, are greater than the weight v, we shall find that the point A will settle in a certain position, and if drawn out of it will always return to it. We say, that in this case, A is in a state of equilibrium, and that the weight v is opposed to the joint action of the weights q and s, and is equivalent to it. Now, an equal weight, x, attached to the cord A W x, going over the pulley W, exactly balances the weight v, in the contrary direction; we say, therefore, that the point A, is affected by the joint action of the weights, q and s, in the same way as if it were drawn upwards by the single weight x. If, therefore, we take A C as the measure of the force of x, or of the equal and opposed force of v, and A D and A B as the measures of the forces of q and s, having the same proportions to A C as q and s have to v or to x; and if we draw the lines C D and C B, we shall find that C D is equal and parallel to A B, and C B to A D, and that the line A C is the diagonal of the parallelogram A B C D. This will always be the case whatever weights we employ, provided *that* one which is in the situation of v be less than the sum of the other two at q and s, and that no one exceed the sum of the other two. We can resolve a motion or pressure, therefore, into two equivalent ones, and combine two forces together, so as to produce a motion, or pressure, in one direction only. It is easy to invert the arrangement now described, and to conceive solid materials used in place of cords. Fig. 5. represents such an adjustment. The beam A T, loaded with the weight v, rests on the ends of two beams A P, A R, whose farther extremities press on the two masses q and s. The pressure on these two beams is evidently in the direction of their lengths. In order to ascertain the amount which either sustains, we take A C to measure the pressure of the beam A T, thus loaded, representing the number of pounds, for example, on a scale of equal parts. Then we draw C D parallel to AB, and C B to A D, completing the parallelogram A B C D. The beam A R sustains a pressure, represented by A B, and the beam A P a pressure, represented by A D, both measured on the same scale. If, in place of the beam A T, there be a weight hung on at A, as x, at the end of the cord A W, whose force is also measured by A C, the pressure on the two beams A P and A R, will remain the same. Nor will it make any difference, if, in place of this rope, a beam be supposed in the same situation, and used in such a manner as that its downward pressure be still represented by A C. In all these cases, it is obvious, that the strain produced is that of compression, and that the measure of it is the same.

But if we vary the angle of inclination of the beams to each other, we vary also the proportion of their pressures. This will be perceived from the inspection of Fig. 6. which may be fully comprehended without any verbal explanation. It will be seen from this figure, similarly to what was mentioned when speaking of Fig. 3. that as the directions of the forces approach there is less expence of power, or, to use a common phrase, the purchase is the greater; and that, on the contrary, the strain on the materials is augmented as their inclination to each other is increased.

But compression, we have seen, is not the only strain to which beams are subjected. They are liable to be drawn asunder. This will be seen in Fig. 7. a case which is of frequent occurrence. The beam A T is not compressed, but suffering tension, and might have its place supplied by a cord or rope, which certainly would not answer if the former sort of strain were that which it had to endure. In this case A T is stretched by a force, represented by A D, and A P, on the other hand, is compressed by a force represented by A B, the line A C being the diagonal of the parallelogram A B C D, and representing the full amount of the force acting at W. A material difference in the strain will be produced by altering the position of AT. Let it be placed in the direction A E, whilst A P remains as before. The pressure on this last will now be represented by A P, and the force of tension on A E by A R, both very much increased. The same thing would happen by changing the position of A P, whilst that of A T remained the same. This will be seen in Fig. 8. In this case, A T is stretched by a force represented by A D, and A P is compressed by a force represented by A B.

Sometimes both the beams sustaining the strain are in a state of tension. This can be easily shewn as in Fig. 9. Here both A P and A E, attached together at A, are drawn downwards by a weight, whose force is represented by A C; it is very obvious that two ropes might be substituted in their place. On the other hand, the force stretching them might itself be a beam suffering tension, in which case all the three beams are on the stretch. This, though unusual, is occasionally met with.

The reader may easily construct a great variety of such figures as we have now shewn; it will be a good exercise for him, as he will thereby learn to discriminate between the two states of compression and tension; and it may be proper to furnish him with a simple rule, the employment of which will prevent his confounding one with the other in any combination of materials. This we shall give in the words of Professor Robison, to whose Treatise on Carpentry, in the First Supplement to the Encyclopædia Britannica, we are indebted for much useful information on the subject.

Observe the direction in which the piece acts from which the strain proceeds. "Draw a line in that direction from the point on which the strain is exerted; and let its length (measured on some scale of equal parts) express the magnitude of this action in pounds, hundreds, or tons. From its *remote* extremity draw lines parallel to the pieces on which the strain is exerted. The line parallel to one piece will necessarily cut the other, or its direction produced. If it cut the piece itself, that piece is compressed by the strain, and it is performing the office of a strut or brace; if it cuts its direction produced, the piece is stretched, and it is a tie." We have given sufficient examples of both for all the purposes we have in view. The following remarks from the same work will be found of utility in studying the principles of structures.

"If the straining piece is within the angle formed by the pieces which are strained, the strains which they sustain are of the opposite kind to that which it exerts. If it be pushing, they are drawing; but if it be within the angles formed by their directions produced, the strains which they sustain are of the same kind. All the three are either drawing or pressing. If the straining piece lie within the angle formed by one piece and the produced direction of the other, its own strain, whether compression or extension, is of the same kind with that of the most remote of the other two, and opposite to that of the nearest."

Thus far of the directions of the strain. As to their measures, it is enough to remark, that they can always be obtained by drawing the parallelogram in the manner we have done, the sides representing it being, of course, measured on the same scale of equal parts as the diagonal. It is necessary now to take notice of the strains as propagated to the points on which the pieces are supported. The pieces, it is evident, are instrumental in communicating the strains to which they are subjected; and it is important to learn how the same measures of the forces will apply to the supports. All that we need to offer on the subject are some general considerations.

Bodies act on each other in directions perpendicular to their touching surfaces. The support, therefore, which a prop gives to a beam is in this direction. Obviously, then, we may, by the same process which we have hitherto adopted, measure its force, and resolve it into two constituent forces. It is unnecessary to go over the steps, as the attentive consideration of what has been said on the subject of the composition and resolution of forces, will enable the reader to make the proper application to the present case. He will not fail to remember also, that the general rules for the discrimination of the strain, whether that of compression or of tension, equally hold true as in the former case. Examples of the force of tension being exerted on the prop are of common occurrence, even where solid materials only are used. This generally happens when the forces act very obliquely on the two ends of a beam, the cohesion of which only operates in resisting the extension. But the beam itself must be supported, and hence we are led to refer the whole frame to something else, of which it is a part. This frame, in fact, becomes an element in a more extensive piece of mechanism, to which it communicates pressure, much in the manner of a lever. The elucidation of this remark is given, in a very beautiful and satisfactory way, in the treatise above-mentioned, to which, and to some other treatises there referred to, we must direct the scientific reader.

Sect. II. *The Construction of Arches.*

By the term arch is meant a building in the form of the segment of a circle, or other curve, used in bridges and other works where great weight is to be sustained. It is an assemblage of materials in the form of truncated wedges, so arranged as to give support to each other when under pressure, and, at the same time, maintain a communication between distant points, without filling up the whole of the intermediate space below. These wedges, which are generally of stone, are called the *voussoirs*, the central one receiving the name of *key-stone*, and the surfaces which separate the voussoirs from each other being denominated the *joints*. Besides these terms, there are others very commonly in use, when speaking of arches, which it is necessary to define. The interior curve of the arch is called the *intrados*, and the outward one the *extrados*. The points on which the extremities of the arch rest, and which are usually masses of masonry, are called *abutments*. That part of the abutment from which the arch springs is termed the *impost*, the beginning of the arch receiving the name of the *spring*. The middle of the arch is called the *crown*, and those parts which are between the spring and the crown are the *haunches*. The arch is said to be an *arch of equilibration*, when the parts of which it consists are so adjusted as to be *in equilibrio*, or to balance one another by their weight only; and this is conceived to be the most advantageous principle on which arches can be constructed. But equilibrium of its parts is not alone sufficient to secure the strength of an arch, the powers of cohesion and lateral adhesion being also employed. The curve of the intrados being given, it is evident, from what has been said, that the weight of the voussoirs is also determined; but here, it ought to be remarked, that as the stones cannot always be made in the proportion necessary for equilibrium, they are supposed to be extended upwards by courses of masonry, and, accordingly, the whole mass included between the planes of their joints, thus supposed to be produced as far as that masonry extends, is understood to constitute the weight of each voussoir. For more particular information respecting the construction of arches, we must refer to those authors who have expressly written on the subject, especially to Dr Hutton's *Principles of Bridges*, and Mr Atwood's Treatise on the Construction, &c. of Arches. Mr Playfair has given the most important principles in his Outlines of Natural Philosophy.

The discovery of the nature and properties of the arch must ever rank among the highest benefits which accident or reasoning has conferred on mankind. To the former we do not hesitate to assign it; and, farther, we think that the theoretical speculations which have been founded on it in modern times, have contributed little real improvement to the maxims which previously existed. This assertion, it is probable, will be borne out by the additional remarks we have to make on the subject. And hence we shall not seem to have neglected the reader's instruction, when we scrupulously avoid the intricacies in which some profound inquirers have continued to involve it. Without calling in question the validity of her claims, we doubt the necessity or utility of the interference of mathematical science, to the full amount of her attainments, in matters which had certainly prospered previously to her exalted pretensions; though we are well aware of the satisfaction that arises in the minds of her votaries, on the discovery of coincidences between her precepts and the successful exertions of untutored genius. But it is too much, to insist that such cases should be ascribed to her inspiration. There is no evidence for such an opinion, and we are left accordingly to imagine, as we best can, how the deductions of a very abstract philosophy, fostered, if not produced in modern times, were anticipated and acted on by the artists of an earlier age. The theoretical principles of arches, in fact, seem not to have engaged the attention of mathematicians till far on in the eighteenth century, while the use of them, even on a large scale, is at least as old as the brighter days of the Roman empire.

Casual arrangement of materials might suggest the rude notion of an arch to the primitive builder. In erecting his wooden hut, it would almost necessarily happen that some of the trees or beams which he employed should assume the position represented in Fig. 10. A. Plate 11. by falling against each other. Or such a position would be certainly given them in order to afford the means of covering his dwelling from the weather. It is obvious, that a beam, having a tendency to fall to a side, in consequence of its centre of gravity being out of the line which passes through its length to the ground, would be prevented from yielding to it by another beam placed in a similar situation, but with an opposite inclination. The two beams thus counteracting each other's tendency to fall, would even acquire a new power to resist a thrust in the plane of their opposition; and this position, accordingly, might be had recourse to, in certain circumstances where a lateral pressure was to be exerted, which could not at all, or at least so securely, be encountered by one beam standing upright. But

Construction

these beams meeting only in a single point, would be easily caused to slip on each other by an oblique pressure, when they would, of course, fall. It was a simple improvement to increase their connection by plaining their heads, so that they pressed together through a larger space. Even the intervention of a third body, between these ends, which, by its form, accommodated itself to both, might be suggested by this slight alteration. It is not unlikely, also, that both the builders in wood and stone might sometimes meet with such an arrangement as is shewn in Fig. 11. B. Plate 10. in the accidental disturbances of their materials. If so, it could not fail to give rise to some profitable reflections. The upper piece, it would be seen, could not fall down unless one or both of the side pieces gave way, and these again, provided their lower ends were prevented from slipping, received a degree of counteracting pressure from it, much in the manner they did when simply leaning against each other. It was no great stretch of reason, although no new accident aided in the discovery, to conceive that two pieces pressing against each other, as in the first case, might be substituted in the place of this single piece, as in the second case. In this last arrangement it would not be forgotten to give a firmer hold to the pieces, by making their place of junction as equal as possible; nor would it seem unnecessary to seek for additional firmness by adjusting their abutting extremities to the ends of the lower pieces. We have now obtained the construction represented in C, and this, in fact, comprises the principles of the arch. If to this a keystone be added, as in the second case, we obtain the arrangement given in D.

So far, the reader will remark, no dependence is put on any cement which might be used to connect these materials. Their stability is altogether the consequence of the proper balance given to them, by which they support one another. We have now both pointed and circular arches; and if we multiply the pieces of which they consist, giving them proper length of joints for resting on each other, and sufficiently supporting the lower part of the sides, so that they may not slip outwards, it is reasonable to think there is hardly any space too wide to be arched over.

We have ample proof of the sufficiency of these simple principles in Gothic buildings, and still greater in the immense bridges which very common workmen have executed. Of some of these examples we shall have occasion to speak presently. All this is not enough for the zealous mathematician, who must introduce his diagrams and analytical investigations, to the utter perplexity of common sense, and, in truth, if followed faithfully, the utter ruin of all good practice.

Dr Hooke, certainly an able man, may be said to have led the way in the introduction of that useless parade to which we now allude. He pointed out clearly enough the principle on which the equilibration of arches might be effected; but, in fact, whatever was good in his theory had been anticipated many centuries before his time, and, on the other hand, some things in it are at variance with the better dictates of experience. We hold it quite useless, then, to occupy much space or time in discussing the merits of the Catenarian curve, as it has been called, or the theoretical deductions which have been made from it. We shall be vastly better employed in attending to the operations of the architect, whilst accomplishing this most important part of his profession, and providing against the evils which reason and experience teach him to apprehend.

Arches are constructed both for ornament and for use. Those of the former kind, having little or no weight to sustain, may be of such curves as are held most pleasing to the eye. Those of the latter kind may seem to require greater caution, as well in the selection of the curve to be given them, as in the mode of finishing. In point of fact, however, arches intended for use have been executed of curves which mere theory would have totally proscribed. Circular arches, for example, have long been common, and are abundantly trust-worthy, though a celebrated mathematical theory asserts their absolute incompetency, unless, which is absurd, and amounts, of course, to an interdiction, they be loaded with an infinite weight where they spring from the horizontal line, or at least that the load, for a considerable distance upwards from the spring, be many times greater than ever will or can be accumulated. These arches, too, it may be observed, when they give way, do so at places very different from those which this theory would point out. And, on the other hand, there is good reason for supposing, that the curve which this theory recommends, is, in fact, almost the only one that would be found defective for common purposes. In short, this theory has made assumptions which seldom or ever exist, and has neglected circumstances of universal occurrence. Architects of the highest repute, therefore, who themselves were acquainted sufficiently with mathematical science to value its injunctions, have abandoned this theory, and betaken themselves to much more obvious principles for the determination of their practice. This will be seen when we describe some of the great monuments of their skill in this branch of the art.

Chap. II. Particular Principles of Construction.

Both carpentry and masonry, the chief practical branches of architecture, afford examples of those general principles. It will be best for our purpose to adduce those only in which there is also some particular display of science. We propose, then, to consider the nature of Roofs, Domes, Centres, and Bridges, on each of which we shall make some general remarks, and afterwards add a few details by way of practical illustration.

Sect. I. *Of Roofs.*

By a roof is understood the covering of a house, serving to defend the interior and its inhabitants from the inclemencies of the weather. It is, therefore, a very essential part of a building; and its due construction, besides, requires a great degree of skill.

The simplest form, next to a mere flat cover, of which we need not speak, consists of two beams, or

Construction

rafters, as they are called, as A B and B C meeting in the ridge B, and resting on the walls E and F; Fig. 11. Pl. 11. A number of such frames, laid parallel to each other, at certain distances, and connected by means of cross or horizontal pieces, on which are fixed the slates or tiling, &c. will answer the purpose of a roof of no great dimensions, and where there is not much weight to be sustained. Even in this simple construction there is room for the exercise of judgment, in the determination of the pitch or height of the roof, and the size or strength of the timber to be employed, besides the consideration of the manner in which the rafters are to be bound together. The best form will be that in which the relative strength of the rafters, and their mutual support, give the greatest product. But this cannot be determined with accuracy on mathematical principles, without taking into account the curvature which the supported rafter acquires, by the transverse pressure of its superincumbent load. This might give rise to rather intricate calculation, and is, of course, altogether neglected by the common artist. Economy usually induces him to prefer a low pitch; and he is generally guided, as to form, by a regard to the appearance of equality in the sides of the roof, or some peculiar circumstances in individual cases.

The chief thing to be regarded here is the thrust which such a roof makes against the walls of the building, tending to push them outwards. This is the most hazardous strain to which they can be exposed, as ordinary walls generally require, from their thinness, to be tied together to prevent separation; and this, accordingly, is often done by means of cross-walls, joists, and roofs. To remedy this pernicious defect in the roof now described, it is usual to introduce another beam connecting A and C together, which, from its office, is called a *tie*, or *tie-beam*. This is shewn in Fig. 12. With respect to the other members of the roof, this can be considered in no other light than as a rope tying the ends of the rafters, so that they shall not press the walls outwards. As, however, it acts with its whole absolute force, and is generally made of larger dimensions than is necessary, in order to admit of being firmly fastened to the ends of the rafters, it is often employed also for carrying the cielings of the apartments under it, and even for supporting a flooring. If made of oak, the tie-beam may be safely subjected to a strain of three tons for every square inch of its section; if of fir, to that of two tons.

But when the tie-beam has a great span, or is much loaded, it may give way, and then the whole thrust of the rafters would be against the walls, as already mentioned. It sometimes yields considerably, or *swags*, as the workmen call it. It therefore needs support, which is afforded by what is known under the name of a *king-post*. This is a very useful contrivance, and admirably answers the end, as may be easily understood by Fig. 13, in which B D represents the king-post. The rafters, we have seen, have a tendency to spread out at the walls on which they rest. This is prevented by the tie-beam exerting a pressure, by which they tend to compress each other. Their weight, however, presses in a contrary direction; and the consequence of this is the stretching of the tie-beam. But if these be in equilibrio, the whole frame, A B C, will retain its shape, and therefore B will become a fixed point, on which the king-post may properly be suspended. The king-post is certainly a tie attaching the tie-beam to the ridge, and suffering tension just as the tie-beam itself does.

Construction

We have now supported our tie-beam; but still our rafters require something to prevent their being bent under the weight of covering laid on them. Any thing of the nature of a tie, is here out of the question; there is no point from which they could derive aid in the way of suspension. But the king-post presents us with assistance. We can raise up *struts*, or *braces*, as they are called, from the foot of it, in the direction of the rafters, to such places as seem most likely to bend inwards. This, of course, is about the middle, to which accordingly the upper ends of the braces are applied, their lower ends being firmly fixed or mortised into joggles, as the carpenters speak, on the foot of the king-post. This will be easily understood from Fig. 14. without farther remark.

These simple constructions are pretty generally applicable, and may be held as the elements from which all the more complicated roofs are produced. There is one piece, indeed, very often employed in comparatively simple roofs, and of course in others, which it is necessary to describe. This is called a *truss*, or *strutting-beam*. It is essential for roofs that have a flat on the top and two sloping sides; those that have a double slope called *kirb*, *curb*, or *mansard roofs*; and others, which, having a valley in the middle, are from their figure denominated M roofs.

Fig. 15. represents a flat-topped roof, of which B C is the truss-beam. It lies between the rafters A B and C D, much in the manner of the key-stone of an arch, and is evidently in a state of compression. The pressure which it occasions on the rafters is the same as if they were produced onwards to the point of meeting, as in the roofs already described, and a weight were laid on them equal to that of B C and its load. We may conceive the truss-beam, indeed, as supplying the place of that portion of the rafters which would be requisite to bring them into contact in the common manner; and if it be of dimensions sufficient to carry its own load, and withstand the compression of the rafters, it will be equally strong. The shape of this roof, however, is not so firm as that before described, at least without some addition in the way of ties or braces to prevent the change it is liable to undergo from unequal weights applied to its sides. The addition of side-posts, such as B E and C F, is a common expedient. The heads of these are secured between the rafters and the truss-beam, or strut, as it is often called, and their lower ends are connected with the tie-beam, which is thus suspended, much as it is by a king-post. This is a very useful construction, as it allows room for garrets. But it is not quite so strong as the former, at least without some increase of timber. The truss-beam is subjected to great compression, besides undergoing a transverse strain from its own load, and the tie-

beam, too, is liable to some degree of transverse strain, when one side of the frame is more pressed down than the other. Fig. 16. shews another construction for a flat-topped roof, certainly stronger, but not quite so convenient for garrets. Sometimes the truss-beam is included very advantageously within the rafters, preserving the common pent form. But in order to obtain the full benefit of it in such cases, what are called butting rafters must be placed under the principal ones, resting on joggles in the heads of the side-posts. An example of this is given in Fig. 17. in which also a king-post is represented as suspended from the ridge of the single rafters, and serving to steady the truss-beam. It exhibits, besides, a set of braces for the upper part of the single rafters, and another for the butting rafters. This frame, therefore, is intended for a wide space, where considerable security is required.

Such, then, are the principal pieces of which a roof-frame is composed, and such is the general principle contemplated in their adjustment. It can rarely happen that more pieces are necessary; if they are so, there is reason to think that some injurious cross strain will be produced. In general, the simpler the construction is, the greater is the security from such an occurrence, and the less the danger of error or imperfection in the workmanship. These pieces may be very variously combined, so as to answer different circumstances.

A case of pretty frequent occurrence, and some nicety, for a simple roof, ought to be noticed. It is where great elevation is wanted within for arched cielings or other peculiar purposes. The common tie-beam would prevent the attainment of this object. Two *hammer*-beams, therefore, or *stretchers*, as they are called, are substituted for it, as is shewn in Fig. 18. and these are connected together with the king-post, somewhat shortened, and the two rafters, by means of iron straps. This is not so strong as the frame in the common way; and as all roofs settle a little, this is apt, by making the points B and D to descend, to cause the rafters to spread out, and hence occasion an outward pressure on the walls. Such a roof, therefore, requires farther management in order to prevent mischief. It may be greatly aided by introducing something like a truss-beam between two rafters, the feet of which are supported lower down on the walls, as is represented in Fig. 19. These take off part of the weight, and lessen the thrust on the walls.

A curb roof, or Mansard roof, as it has been called after the inventor, is a still more ingenious contrivance, and may rank indeed amongst the chief productions of modern carpentry. It is formed by the application of four or more planes to each other, so that each two may have an external inclination, the ridge being the point of meeting of the two middle planes. It may be constructed for any given height and width, and with any number of rafters. On this account, and because the lower rafters may be made to spring at a very small angle from the walls, occasioning therefore little lateral pressure, this roof has important advantages over the common ones, where great space is required immediately below it. If the sides be properly balanced, or the rafters have a just proportion to each other, in which alone consists either the difficulty or the excellence of the structure, this roof admits of the upper part being a complete void to the very ridge, or forming a cylindric arch, in which respect it differs essentially from all those roofs which require tie-beams, king-posts, &c. in their construction. For the theoretical and practical principles of curb-roofing, we refer the student to Mr Nicholson's Architectural Dictionary. Figures 20. and 21. represent the outline of some of the usual forms which it takes.

We have still to notice another kind of roof, before we proceed to describe some remarkable examples. It is denominated a Norman roof, from the circumstance of its having been often used by the people of that name, after their establishment in the southern countries of Europe. Its structure is ingenious, is capable of great strength, has a pleasing appearance, requires only small pieces of timber, and, like the last-mentioned, exerts little lateral pressure on the walls. In this roof, represented in Fig. 22. all the rafters are butted on joggled king-posts, of which there are several, as A F, B G, &c. and there are braces, or ties, placed in the intervals. Such is the general principle, but there are several modifications to be met with, which, however, we do not think it necessary to particularize. We have noble examples of Norman roofs in the Parliament House at Edinburgh, the great hall in Tarnaway Castle, belonging to the Earl of Moray, in Scotland, and in Guildhall, London.

The following examples of roofs are chiefly taken from Nicholson's Carpenter's and Joiner's Assistant, Lond. 1810, which the artist, who desires to be particularly informed respecting the dimensions of the different pieces, will do well to consult. We shall content ourselves with general observations.

Plate 12. Fig. 1. is the old roof of St Paul's church, Covent Garden, as executed by *Inigo Jones*, which was consumed by fire in 1795. It is somewhat singular, the nature of the building requiring it to project over the walls, which it does to the extent of seven feet on each side. It could not rest therefore on the tie-beam, the ends of which were employed in the support of certain external ornaments, of what has been called the Tuscan order, to be afterwards spoken of. But the deficiency is artfully remedied, and that too with little timber. This was reckoned the highest roof of its width in London. Mr Nicholson points out some imperfections in this structure, which, however, we think it unnecessary to specify. We agree with him in giving the preference to the new roof, Fig. 2. as both simpler and stronger, though, to use his words, 'it must be observed, in favour of the modern improvements in carpentry, that a truss of the old roof contains about 273 solid feet of timber, whereas the new roof contains only about 198 feet in each truss." The whole length of the tie-beam in both roofs was 72 feet. Fig. 3. is the roof of Islington church, near London, built about the year 1752. Sundry and serious objections may be made to it, being complicated, occupying much timber, and subjecting the pieces from the form and positions given them to revolve at the angles. In place of it Mr Nicholson proposes, Fig 4. as much better suited to the

purpose, and evidently stronger, though taking less timber. We think the claim is just. Fig. 5. is the excellent roof of the chapel of the Royal Hospital at Greenwich, constructed by Mr Samuel Wyatt about the year 1785. It is flat on the top, having what is called a camber beam for supporting the platform. The king-post is of iron, and the joints are secured by iron straps. The structure, though simple enough, is far from being a common one. It is in such performances that the genius of an artist is to be seen. Fig. 6. the roof of Birmingham theatre, constructed by Mr George Saunders in 1794, has very great merit, being well adapted to the circumstances and required magnitude, whilst the construction is simple and employs little timber. The open space in the middle, it will instantly be understood, is used for the various work-rooms, &c. necessary in a theatre. Fig. 7. the roof of the present Drury Lane theatre, constructed by Mr Wyatt, which we have copied on a reduced scale from his account of that edifice, is an admirable combination of simplicity, strength, and conveniency. One of the most scientific, and certainly the largest roof we have ever heard of, is that of the riding school at St Petersburgh, said to be the production of a native of Scotland. We are indebted to Mr Charles Black, builder in Edinburgh, for a drawing of it, a reduced copy of which is given in Fig. 10.; and to Mr James Haldane, teacher of architectural drawing in the same city, for all the information respecting it that we have been able to procure. A short time before his death, Professor Robison employed this last gentleman to make a draught of it from the scroll and particulars communicated in a letter of a Russian nobleman. The professor, an excellent judge, conceived it a master-piece of carpentry, and no doubt intended to make it generally known through the medium of some literary publication. This, at least, as far as we know, was never done. The reader will scarcely hesitate in thinking, that we do a service to a useful art by the present notice. Whoever attentively considers the width of this roof, viz. 126 feet clear within the walls, (that of old Drury-Lane and Birmingham theatres being only 80,) the lowness of its pitch, the skilful adjustment of its various pieces to the nature of the offices which they perform, and its general indication of judicious design, with the production, at the same time, of very pleasing effect, must admit, we believe, that, both as a study and a model, it merits the very highest commendation. With this fine example, then, we conclude our account of roofs.

Sect. II. *Of Domes.*

The subject of domes is intimately connected with that of roofs, a dome being, in fact, an arched or vaulted roof. They vary in appearance according to the nature of the surface from which they arise, and the height to which they are carried, and obtain, consequently, different names. Thus they are circular, elliptical, or polygonal; and these two may be subdivided. When they arise higher than the radius of the base, domes are said to be *surmounted*; when they are of a less elevation they are called *diminished* or *surbased* domes. Such as have circular bases are termed *cupolas*. They generally present a convex surface outwardly and are concave within; sometimes though rarely in this country, they are made convex below and concave above; and it is certain, from the principles on which they are constructed, that they might be made with a convex surface inwardly and a concave one outwardly, and yet be equally if not more firm.

The construction of a dome evidently requires science. Most persons, it is presumed, will conceive it more difficult than it really is. There is considerable advantage, in fact, in some of the usual circumstances of domes. We see, accordingly, that common workmen, without any particular attention to scientific rules, succeed perfectly in building very lofty edifices of this kind, such as glass-houses and potters' kilns. It would be extremely difficult to raise a pent roof to half the height of some of them. In the case of a cone, then, at least, some facility seems to be afforded by the roundness of the horizontal section, and therefore we find that even very small materials will suffice for accomplishing the structure. The chief thing to be regarded in this case, is a provision against the bottom flying out, which we can have in an iron hoop or a stone bandage, &c. It is easy to understand, that if all the joints of this building be directed towards the axis, they will all have an equal tendency to slide inwards, and therefore, as no one can have a preference, that they will hold one another in equilibrio. The pieces, in short, are wedges, and operate as such. On the same principles, it follows, that a dome may be loaded immensely at top, with perfect safety, so long as the bottom course is prevented from bursting; nay, that such load may even have a good effect in guarding it from the injurious operation of an irregular pressure on its sides. We have a good example of what a dome may bear, in this way, in the case of St Paul's cathedral, London, the production of the celebrated Sir Christopher Wren. The exterior dome of this fine building, which is constructed of oak-timber, supported by a brick cone arising from the same base, sustains on its top a stone-lantern, weighing the enormous quantity of 700 tons. The pressure in such cases is propagated along the cone in the direction of the slant-side, and that, too, equally throughout, so that no part can have an inclination one way or another more than the rest. The familiar fact of the great compression that may be made on an egg, when held lengthwise between the hands, may serve as an illustration. Besides the hoop at the base of this dome, there are hoops in different courses of the cone, which secure it, and at the same time cause it to press quite vertically on the piers. Indeed, altogether, the constitution of this dome, and the arrangement of the other parts of the building, so as to correspond with it, display the greatest judgment. The dome is represented in Plate 12. Fig. 11. from Mr Nicholson's work before alluded to; and the following explanation cannot fail to interest the reader. A A a a A A, is the dome of brick already mentioned, two bricks thick, and having, at every rise of five feet, a course of excellent brick of 18 inches long, bonding through the whole thickness. This dome, it may be remarked, was turned upon a centre, of the nature of which we shall soon have occasion to speak, and was afterwards beautifully painted by *Sir James Thornhill.*

B B b b B B is another cone of bricks, one foot six inches thick, and this is also painted. Part of this cone may be seen through the opening at a a, by a person standing on the floor of the church. It is on this cone that the timber work is supported, the horizontal beams C C, D D, E E, F F, being tied into G, H, I, K, by means of iron cramps.

The diameter of the dome is 104 feet, and there are 32 trusses in the circumference; but the scantling of none of the timbers, it ought to be remarked, is so great as is to be found in many churches. The stairs which lead to the golden gallery at the top of the dome, are carried between the trusses of the roof. The sides of the dome are segments of circles, which, if continued, would have formed a pointed arch at the top; on which is built the cupola of Portland stone, 21 feet in diameter, and nearly 64 feet high.

The dome of St Peter's church, in Rome, designed by Michael Angelo, is nearly an ellipsoid externally, having the longer axis perpendicular to the horizon. It rises perpendicularly from its base, where it is very thick. At the height of 50 feet, the vaulting divides into two, gradually separating from each other, but connected by thin walls dovetailed into each shell, and thus forming a very stiff covering. There is an elegant stone lantern on the crown of the dome. If this dome had been of the same size as that of St Paul's, it would, from the manner in which it is constructed, have been at least five times as heavy; but it is so well supplied with iron bars, and other contrivances, that no doubt can be entertained of its durability. It has long been the admiration of the world, and would itself have established the character of the artist.

The dome of the Pantheon at Rome, still extant, is the oldest of which we find mention in history. It was built in the reign of Augustus, and, like all the ancient Roman domes, is a much less portion of a sphere than a hemisphere. It terminates in an opening, called *the eye.*

Next in antiquity to the Pantheon, but greater in fame, is the dome of St Sophia, at Constantinople, erected in the reign of Justinian. Its early misfortunes were ominous of its fate, and the ruin of the eastern empire. Anthemius, a Greek architect patronized by the emperor, undertook to erect a dome over the church that had been raised on the ruins of a former one built by Constantine, which should surpass the boasted grandeur of the Pantheon. He wished, by a natural enough ambition, that the cross might triumph over the Pagan world, and the greatness of the object called forth all the energies of his mind, and the accumulated experience of his art. The church itself was in the form of a cross, and it was vaulted with stone. Ten thousand workmen are said to have been employed in it, and it was finished within six years after laying the foundation. No wood was used in its structure, except for the doors, the remembrance of former calamities having excited strong apprehensions of the agency of fire. The dome was raised on a ring formed by four pillars placed at the angles of a square, about 115 feet from each other, and arched over, and having the angular spaces fixed up so as to constitute a complete circle. Additional securities were sought. Four walls, nearly solid, running longitudinally, two from the south, and two from the north sides of the pillars, from the distance of about 90 feet, were intended to resist the pressure of the east and west arches; and besides this, these arches were abutted upon by half domes, resting on cylindrical walls, capable, it was believed, of resisting the pressure of the north and south arches. In this last office four columns of Egyptian granite assisted. But all was insufficient, as a few months after its completion, the dome gave way on the east side, carrying with it the contiguous semi-dome. Isodorus, who succeeded Anthemius on his death, made an unsuccessful attempt to aid the original plan, by filling up some vacuities. The new dome gave way before being quite finished, and also on the east side. A third time was it constructed, with farther help from buttresses, and the greatest care to have the structure made light, by employing pumice-stone, in place of more ponderous materials, and keeping the walls slender, &c. Even these precautions, it seems, would have proved ineffectual, if the arches on the north and south sides had not been filled up with new ones of smaller size, in three stories. Some visible fractures in the arches shewed the necessity of such assistance. It is clear, that the architect of this extraordinary edifice, who was allowed to be the first of his time, was not well acquainted with the scientific principles of dome vaulting. If he had, there cannot be a doubt that he would have secured the base by hoops, so as to render the pressure as much as possible a perpendicular thrust. In this respect he has been much surpassed, and with perfect security, by both Michael Angelo and Sir Christopher Wren; and perhaps any common architect, in modern times, would be sure to avoid the blunders committed in this clumsy building.

Arnolfo Lusii projected a dome for the cathedral at Pisa, but dying two years after, no architect could be found to execute it according to the original plan. It remained unfinished for more than a century. Then, in a consultation of the principal architects of Europe, Philip Brunelleschi, a native of Florence, intended at first for the bar, but whom nature destined for this profession, asserted the possibility of erecting a double cupola, with sufficient room for a staircase between to reach to the top; and consequently gave in a proposition to that effect. This was conceived absurd, and in fact an insult on those who had assembled. He was accordingly dismissed with indignation, and had, for a time, to bear the sarcasms of his brethren. But as none of them offered any thing suitable for the purpose, the persons who had the management of the building were induced to pay some regard to his device, and at last to agree to an attempt at its execution. Some conditions were imposed on him, and, in the first instance, an ignorant assistant. Getting free of him shortly, he proceeded in his plan, and at last accomplished it, though the lantern with which he purposed to crown the work was not finished in his life time. This cupola is octangular, 154 Flemish cubits in height, and the lantern, of which Brunelleschi left the model, 38 cubits; over this is a ball and then a cross, the whole being above 200 cubits in height, which is greater than had ever before been attempted on such a plan. Its dimensions, indeed, are greater than those of any of the Roman domes, with the exception of St Peter's.

The very remarkable wooden dome of the Halle du Blé at Paris, which was destroyed by fire some years ago, merits description. Its construction, invented by a carpenter of the name of Molineau, was extremely simple. It occurred to this man, that a thin shell of timber might be made so as to be nearly in equilibrio, and also, when firmly hooped horizontally, to have all the stiffness that was requisite. His project was submitted by the magistracy of Paris to the consideration of the Academy of Sciences, by whom it was favourably entertained, the members being highly pleased with the justness of the principle on which it was founded, and at the same time surprized that it had not been thought of before. The circular ribs comprising this dome, consisted of planks nine feet long, 13 inches broad, and three inches thick,—three such planks, bolted together so that two joints met, forming each rib. All the pieces being small, no machinery was required for carrying them up. The ribs were connected together by horizontal timbers, and iron straps, which answered the purpose of hoops. When the work had reached a certain height, every third rib was discontinued, and the open space was glazed. At a certain height above this, again, every second rib was discontinued, and the vacancy in like measure glazed. Higher up, still, the heads of the ribs were framed into a circular ring, so as to form a wide opening, and over this was placed a glazed canopy, in which was left a space for the escape of heated air. This dome, which was 200 feet in diameter, and only a foot thick in the sides, was extremely beautiful, and used to be spoken of with admiration by all who had seen it.

The chief objection to wooden domes, is their incapacity to sustain great weights. Wherever this is required, it is evident that we must have recourse to trussed frames similar to those we have already described; for it would be absurd to trust to a mere shell which could not fail to be crushed in at the top. There are not many cases, therefore, in which they are useful.

Mr Bunce has lately invented a dome, which we shall describe in the words of Mr Nicholson: "In this construction, all the abutting joints are continued in uninterrupted vertical planes; but the horizontal joints of every two stones break on the middle of the stones on either side; so that every alternate stone of a course projects upwards, and leaves a recess for the insertion of the stones of the next course. Upon this principle, the intervals, as the building approaches nearer the top become more wedge-formed, and, the interior circumference being less than the exterior, the stones can be inserted only on the outside; consequently, if made so exact as just to fit into their places, they cannot fall inwardly. This mode of joining stones may be convenient, as requiring no centering; but unless the courses be nicely equilibrated, it is more liable to burst than when a dome is constructed in the ordinary manner, since every row of stones, from the base to the top, forms an arch independent of the rest."

The octagonal pyramids, which constitute so remarkable a feature in Gothic architecture, are to be understood on the same principles as those of domes. They are very firm though thin, and certainly exhibit much science. Our spires and steeples are of this description, and these, it is well known, are extremely various in form and magnitude.

It is obvious, then, that great freedom has been taken with the principle of equilibration, whether well or ill understood. Few persons will doubt, we believe, that accident or whim has done more to discover it than science. It is extremely improbable, indeed, that the generality of the artists who have excelled in this way, were so profoundly conversant with mathematics as to be able to deduce their practical rules from its abstract speculations. Yet the whole theory is capable of the strictest demonstration, and has actually obtained it from some learned men. We hold it quite foreign to our purpose to enter on such a task, and shall content ourselves, therefore, with a very few additional remarks of a less abstruse nature.

The stability of the dome is in general much greater than that of an arch, and, on the whole, is easier obtained. The dome also, as we have seen, may be left open at top, in which it differs from the arch. Even the equilibrated dome, which is the weakest, will admit of this; and it will admit also another building to be laid above it, as a lantern, provided the weight of this addition be not greater than that of the circular segment of the dome that is left out. If the curve of the dome be flatter than the curve of equilibration, the load it will sustain may be increased above this amount. Lastly, almost any load whatever may be laid on a dome in the shape of a truncated cone, or one in which the contour is convex towards the axis, provided the base be secured by a hoop in the way formerly mentioned.

Domes are generally intended for ornament. They admit of immense variety in form, so as to suit every fancy. Those of a concave exterior, which are often seen in Gothic buildings, particularly when vaulted over with circular sweeps, have an uncommonly pleasing appearance. Domes, in general, are lighter than any other covering of the same area; and as they allow of cylindrical intersections in every direction, spring gracefully from any polygonal surface, and may be broken off at any height, they must be considered as possessing very eminent advantages in the higher departments of architecture.

Sect. III. *Of Centers.*

The term center is used to denote a mould, or frame, generally constructed of wood, by which the materials of vaults or arches are supported during their erection, and from which they receive their particular shape.

In common cases, as where the space to be arched over is small, and admits of intermediate points on which carpentry work can be raised, the construction of centers is attended with no material difficulty.

Any of the frames or trusses used for roofs will be sufficient for carrying the weight and establishing the shape desired. The principles formerly explained, therefore, of the abutment of rafters, the prevention of their lateral secession from each other by tie-beams, &c. are here in full force; and some very inconsiderable modifications of external form, which can be readily attained by the same means, or the addition of merely shaped timbers, are all, in general, that such occasions require. Much more urgent are the demands when the span is wide, the weight of materials consequently great, and when, from the height of the arch, or the intervention of deep water, continually navigated perhaps, no intermediate support can be procured. Such a case calls for the greatest solicitude, and is an opportunity for displaying the utmost invention and science of the artist. Here every thing must rest on the piers, or sides, and the centre or frame, by which the materials of the arch are to be supported, must itself be an arch, dependent on the relations of its constituent parts. Common workmen, not aware of this, are in the habit of heaping timber on timber, with little regard to any thing but the ultimate form, as if strength consisted in quantity merely, and there was no danger to be feared from the very weight of the pieces which they were so awkwardly combining together.

The mechanical principles already explained will lead us to more judicious, and, at the same time, less expensive and less hazardous constructions.

As the utmost strength of which the materials are capable may be necessary in this nice art, it must always be remembered to place them in such a manner that they shall not be subjected to any other strain than what is in the direction of their length. This, we know, may be in two ways, compression and tension. The former is always to be preferred where it is practicable, as in the case of the drawing of timber, the material to which we are now chiefly alluding, reliance must be put on the manner in which the beam is united at its ends with other pieces, and this is almost necessarily a weak security. Sometimes, indeed, it is impossible, or at least very difficult, to avoid ties, and they are accordingly to be seen in good specimens of carpentry. But an unskilled workman can scarcely be trusted with them, and even the highest artists ought to employ them with the greatest caution, and as seldom as possible. Universally, it is of essential consequence to know whether a piece be acting the part of a tie or not, that if it be, the requisite securities may be afforded it; and no piece ought to be introduced without a thorough examination of the nature of the strain to which it is likely to be subjected. Even the occasional variations which may and will occur during the progress of the work, especially from what is almost sure to happen in some degree or other, the sinking of the arch, ought to be guarded against to the full extent of professional foresight.

Thus far of the strength of centers. They must also be so stiff or immoveable, that no weight that can be laid on them shall vary their form. Suppleness, supposing it consistent with strength, which it may be, is an essential imperfection in a center, and must be obviated by the proper employment of struts, which will hinder any change in the angles of the pieces. It is an important practical maxim for a structure of this kind, in which changes of pressure are almost continually taking place, and very often without allowing time for new contrivances, to make the timbers capable of undergoing both the sorts of strains now mentioned. Nothing indeed is more usual than for the same piece to be subjected at one time to compression, and at another time to be liable to be drawn asunder. But it is certain, that, with the exception of the pieces which immediately sustain the parts of the arch, and which may be perfectly accommodated, each to its own share, all the requisite timbers may be placed so as that none of them shall be exposed to a transverse strain. The strength of the timbers, it is almost needless to say, must be estimated according to the circumstances of the case and the quality of the materials. And with respect to the relative position in which they are to be placed, it is proper to observe, as aiding in this estimate, that it is the upper part of the arch which presses most on the frame. This will be very obvious, indeed, when it is considered, that each archstone to be supported, inasmuch as it lies on an inclined plane, has a tendency to slide down in proportion to its relative weight; or, in the language of the mathematician, that its weight is to its tendency to slide down the plane on which it is supported, as radius to the sine of elevation of that plane.

No rule perhaps can be given for determining the absolute pressure in different arches. On the whole, there is room for concluding, that, in those that are circular, and of a high pitch, about two-thirds of the weight are borne by the center before the key stone is laid on, and that in arches which are either elliptical or low pitched, the proportional weight to be sustained by it is greater than this amount. The nature of the curve, therefore, must be considered in adjusting the magnitude or dimensions of the pieces. In all cases, it is obvious, the greatest attention is required in securing the abutments of the center, on which the stability of the whole ultimately depends. Where the nature of the space to be arched over will admit, it is always preferable for this end, that the entire opening be divided into two or more spaces, and that supporters be raised up, properly secured, on which, in addition to the piers, the center may be erected. In such cases, fewer timbers and less complicated workmanship are needed. But such aid, as has already been noticed, cannot always be had; and often indeed, even the advantage of a long tie-beam is unattainable, from the circumstances of vessels passing, or the liability of a river to be greatly augmented in size by tides or heavy rain.

Examples.—We now proceed to describe different kinds or examples of centers, premising only what the intelligent reader will have already understood, that the strength and stiffness of all of them are ultimately to be found in the triangular frames or trusses into which the centers, however complicated, may be resolved.

Various principles have been adopted for the construction of centers, by different artists, some of them deserving particular notice.

That adopted by M. Hupeau for the bridge of Or-

Construction

leans in France, is one of the boldest ever executed, and is, at the same time, a very simple piece of carpentry. It may be considered as in fact one large truss spanning the entire width, supporting at its top the upper part of the arch, and having its rafters occupied as foundations for smaller trusses, on which the other parts of the arch are sustained. The reader who has attentively considered the principles of construction formerly laid down, will easily comprehend the general nature of this center from the view given of it in Fig. 1. Plate 13. But that we may not mislead him into unqualified praise, it is requisite to say a few words on the history of this case. The arch is 100 feet span, has a rise of 30 feet, and the arch stones are 6 feet long. The architect died when only a few of the first courses of any of the arches had been laid. M. Perronet succeeded him, and completed the work. As it advanced, the vertex of the center rose a good deal, and on being loaded, sank as much. This shewed the weakness of the frame, and that its lower parts especially, were giving little assistance. The two long beams, a d, f g, which form the diagonals of the quadrangular spaces a b c d, e f g h, were therefore added to it, when it became sufficiently strong. These pieces are nearly in the line (continued) of the lower beams, and certainly quite alter the nature of the frame, bringing it to the state, as we have called it, of one large truss, consisting of two long rafters, and a short straining beam placed horizontally between them. The former, it will be seen, are trussed up about their middle, so as to form the side frames, and the latter constitutes the summit of the center. Some additional means were found requisite to support the center during the course of the work. It is certainly far from being entitled to be held as a perfect performance, nevertheless it is an admirable example of what simplicity and attention to the elementary rules of construction are able to accomplish.

Centers may consist of two trusses independent of each other, one supporting the crown of the arch, and the other the sides, or haunches, as they are called. Of this kind was the frame employed by the illustrious Michael Angelo, for the nave and transepts of St Peter's church at Rome; and on the same principle, a little modified, are two centers proposed as a lesson by M. Pitot, a member of the Academy of Sciences. A few remarks on these examples may prove amusing as well as instructive.

A person of the name of San Gallo is said to have constructed Michael Angelo's center. It is a judicious performance, and abundantly effective, erring rather indeed in an excess of strength, and the employment, consequently, of an unnecessary quantity of timber. It is shewn in Fig. 2. and will be easily discerned to be divisible into two parts, of which the superior sustains the greater weight. We agree with Professor Robison, that the innermost polygon, that is to say the lowermost one, is superfluous, as no strain can force in the struts which rest on the angles. The triangle immediately resting on it is pretty much in the like predicament; and one might imagine that the artist thought the king-post acted as a pillar and not a tie, so that he judged it requisite to secure the tie-beam against cross strains from it.

2

In Fig. 3. is represented one of M. Pitot's proposed centers. It is so simple as to be readily comprehended, and has great merit. With the exception, perhaps, of the principal stretcher, which extends the whole width of the arch, a little above the middle, all the pieces that are any way essential to the construction are subjected to one kind of strain, viz. that of compression; and this, as we have already noticed, is an excellence of the highest value. This center is proposed for an arch of 60 feet span. Some objections may be made to it, but we do not think it necessary to state them. Of its sufficiency we have no doubt. The other center proposed by the same person for an elliptical arch, and used by him. we believe, in the middle arch of the bridge at Lille-Adam, being 80 feet span, and rising 31, precisely corresponds with it, and need not therefore occupy our attention. They are both, perhaps, inferior in simplicity and strength to the first one described of this class.

The next examples we shall give are of a more complicated construction. The principle is that of inscribed equilateral polygons. In this, each truss, which consists of a number of struts, placed end to end, so as to form a polygonal figure, stretches over the whole space between the piers. When arranged, the angles of one such truss occur in the middle of the sides of that which is next to it, and so on alternately, till as many such polygons are erected as seem sufficient for the purpose. The trusses, it is certain, may be quite independent of each other, and even when combined together, have been supposed to operate as if they were so, and that in consequence the full amount of their separate agency is thereby obtained. This is very problematical; but, at all events, it has been found expedient to have them united, whatever be the precise mode in which their action is realized. By the nature of the construction, it will readily be conceived, the angles of the alternate trusses are situate in lines pointing towards the center of the curve. In consequence, king-posts, consisting of two beams, one on each side of the truss, and embracing the truss-beams between them, are placed in this direction, pointing towards the center. Other contrivances, which it is unnecessary to particularize, are employed to effect a secure junction; and it is imagined, that, when loaded on the top, the whole will gradually, but conjointly, be brought to sustain the pressure. Perrault, a physician, is said to have invented this construction; but the principal artist who has availed himself of it is Mr Perronet, the architect employed for the bridges of Cravant, Nogent, Maxence, and Neuilly, in which cases it was adopted. They differ from each other in several respects, as accommodated to peculiar circumstances, and seemingly in order to remedy those deficiencies which experience pointed out. We have, therefore, represented the whole of them; but we must confine ourselves to very general remarks.

Fig. 4. is that of Cravant. The arches in this case are elliptical, of 60 feet span, and 20 rise, and the arch-stones were four feet in thickness. The whole weight of the arch was about 558 tons. Though the center was perhaps superabundantly strong, it nevertheless yielded a good deal, and consequently re-

Construction

quired some management in order to have its shape preserved.

Fig. 5. A. represents half of the center for the bridge of Nogent, being an arch of 90 feet span and 28 rise; arch-stones $4\frac{1}{2}$ feet thick, and the unreduced load on each frame nearly 235 tons. It cannot be doubted, that this center, from the dimensions of the timber used in its construction, was vastly stronger than was needful.

Fig. 5. B. shews half of the center used at the bridge of Maxence. The span in this arch is about 76 feet, and the rise little more than six. Its appearance, therefore, is disagreeably flat, and will probably seldom have imitators. The center is a very judicious one of its kind.

Fig. 6. is a delineation of the center employed in the bridge of Neuilly. Here the arch is 120 feet span and 30 rise, the arch-stones being five feet thick. This center was strong enough, but much too flexible. It consequently yielded and twisted very remarkably at different periods of the work. This ought to have been foreseen; for it is quite manifest that the angles of the trusses throughout are vastly too obtuse. Fewer pieces ought to have been employed. This would have required the angles to be acute; the feet of the lower trusses, too, it may be observed, would have been much better placed at a lower part of the pier. This last remark applies generally to M. Perronet's centers, in all of which the feet of the trusses are too short and narrow. It is, on the whole, very unlikely that his practice in this and in several other points will be adopted in our country, where a much better model is to be had, as we shall immediately show.

The center to which we now allude is that which was used at Blackfriars bridge, London, by Mr Mylne. Its principle is perfectly simple, that of supporting different points of the arch by trusses, consisting of two legs or rafters, the feet of which rest on the piers, one on each. The rafters have an intermediate piece, called an apron piece, applied at top, which is useful both for strengthening the exterior joints, and giving stiffness to the ring on which the stones are laid. This will all be easily understood from Fig. 7.

The rafters, or legs, consisted of several pieces firmly abutted together, and occasionally secured, moreover, by double king-posts; but sometimes where they intersected, they were halved into each other. This last mode has been objected to, as tending to weaken the beams; but it seems to be almost necessary, owing to the frequency of the intersections; and at all events, it is certain, from the nature of the construction, as well as the dimensions of the timber used in this case at least, (the legs being 12 inches square,) that the center was abundantly strong and perfectly firm. As an evidence of this, it is proper to mention, that not the smallest sinking or twisting was observed in the progress of the work, and that the whole sinking of the crown, before setting the key-stones, did not amount to one inch. Greater security than this, surely, is not desirable; and if we except the consumpt of timber, which is certainly considerably greater than in M. Perronet's centers, no reasonable objection can be made to this plan. The reader will observe, that the upper part of the center, where, of course, great support is needed, is fully accommodated to its office by the simple truss of equal legs extending from side to side; and that though, in the lateral points, particularly those that are low down, one of the legs of the truss is very oblique, this disadvantage is compensated for by the nearly upright position of its antagonist. The principal arch in this bridge, it ought to be mentioned, is 100 feet span, and its height from the spring 43 feet, the arch itself being above 6 feet in thickness. The center employed in Westminster bridge, Fig. 8. was constructed on a very similar principle, which, it cannot be doubted, is perfectly suitable to arches of any width.

Other centers have been proposed, and sometimes adopted, but we do not think it necessary to particularize them. Those we have mentioned are sufficient for the general purpose we have in view, of putting the reader in possession of elementary knowledge. We cannot conclude this part of our subject without noticing a recent proposal for a center of a very different kind from any hitherto employed. It is the invention of Mr Telford, but, as far as we know, has never yet been adopted. This gentleman, according to a printed report of a committee of the House of Commons, on the most effectual mode of improving the mail roads in Wales, &c. recommends a cast-iron bridge to be laid across the Menai, a small arm of the sea, dividing the island of Anglesea from Caernarvonshire, through which the tide runs with considerable velocity, and which is constantly navigated by pretty large vessels. In furtherance of this advice, Mr Telford proposes a single arch of no less than 500 feet span, 100 feet in height above high water at spring tides, and 40 feet in breadth. The nature of the bottom of the channel, the depth at low water, and the great rise and rapidity of the tides, render the common modes of centering from below very difficult, if not impossible. A plan then is devised for accomplishing it from above, which as far as can be understood from the description afforded, has a plausible enough appearance. It is impossible not to admire the ingenuity and boldness that could suggest so stupendous an undertaking; and if it shall be found practicable, it can scarcely be doubted that it will give rise to more magnificent structures in this department of architecture than the world has yet seen.

Striking a center.—A few words on the mode of striking a center, as it is called, will finish what seems necessary for the general reader on this part of our subject. To separate the scaffolding from an arch, so that it may not receive any material alteration from the want of support, is a nicer operation than most persons might at first imagine. This will appear from a few very simple observations on the state in which the arch stones rest on the centering, and on one another. We have already noticed that they are mostly supported on the center, previously to the adjustment of the key-stone. But they are not all equally so. The lower courses lean much more on one another, and those which are towards the crown, on the other hand, are nearly altogether sustained by the center. Besides this, the

Construction. mortar used for connecting them is but little compressed during the continuance of support from the center, and least of all, of course, about the upper parts; and if much time has been occupied in the work, it must necessarily be in different degrees of consolidation. It follows, then, that an instantaneous and total removal of the support, would be productive of irregular, and, in fact, irremediable settling; probably, indeed, the upper stones would fall out, and the whole arch be destroyed. The gradual removal of the center, therefore, seems plainly dictated; and it is no less obvious, that it ought to take place first from the lower parts of the arch, or, at least, in such a manner that the natural process of abutment which takes place amongst the different courses may be secured. Various plans have been adopted. "The best method," says Mr Nicholson, "is to let the center down all in a piece, by easing some of the wedges, (introduced between the centers and beams on which they rest, and employed for this purpose;) to let it rest there for a few hours, in order to try whether the arch makes any efforts to fall, or any joints open, or stones crush or crack, that the damage may be repaired before the center is entirely removed, which is not to be done till the arch ceases to make any visible efforts." M. Perronet was in the habit of cutting away the blocks, or bridgings, as they have been named, on which the arch-stones immediately rested, beginning with the lowest on each side, and advancing gradually upwards, but rather quickly, till all that had been put out of shape any way, by the bending or shrinking of the center, was quite detached. The haunches, now unresisted, pressed inwards, and, of course, harder than formerly, on the arch-stones which were nearer to the crown. When this had taken place for some days, he proceeded, but with greater caution, to destroy the blocks under those upper stones. This always produced some degree of shifting, and towards the end seemed to occasion a very irregular curve, and a good deal of rising and sinking, against which he had to employ several cautionary or remedial measures. The former method, which with sundry modifications is generally practised in this island, is vastly to be preferred, and the happier fortune of our artists is the most satisfactory test of its superiority. Mr Mylne's process for accomplishing this delicate and important business was peculiarly excellent. The view given of the centre used by him at Blackfriars bridge, already described, shews the pieces concerned in it.

Sect. IV. *Of Bridges.*

Bridges are the most remarkable examples of the use of the principles of the arch, and merit, from their beauty and advantages, the most attentive consideration.

Wooden bridges.—We commence with those which are built of wood, between which and the examples of centers just now given there is a close and obvious connexion. The rules recognised in their structure may be easily traced to the general principles formerly detailed, and need not, therefore, occupy much attention at present. But the following preliminary remarks will be found of utility to some readers.

There are two ways in which a piece of timber, A B, Plate 12. Fig. 11. may be supported at C, its middle point, where it is exposed to greatest stress in its position across a river. 1. It may be suspended by ropes, &c. &c. as D C, E C, from two fixed points D E, above it; or it may be propped up on the ridge of two rafters, as d C, e C, resting on two fixed points, d e, below it; and, 2dly, It may be connected with a point that is so supported, either by suspending it by a king-post, as F C, coming from the ridge of two rafters, as A F, B f, or by resting it on a strut, as C F, which itself is supported by two ropes, as A f, B f.

Whichever way be adopted, it is very evident that the support is the more powerful as the angle formed at C, by lines drawn from these points, is the more acute. Either plan may be strong enough; but the first case requires greater extent of space; and besides this, it may not always be convenient to find adequate points of support either above or below the beam; whereas the second, requiring no other fixed points than A and B, is always practicable. This second method, therefore, is most commonly adopted. Room, in short, can always be found for the simple truss A F B. As the length of the king-post does not add to the support of C, it may be proper to find two points, as a and b, in Fig. 12. at a moderate distance below A and B, from which to erect the rafters, and to employ a shorter king-post. If the parts A C, C B, of the beam A B, are conceived still too weak, though by this means its strength is vastly increased, it may be further aided by trussing each half, as is shewn in Fig. 13. which is a very simple, but at the same time a very strong, and rather neat construction for a bridge, the intersections of the secondary braces with those of the main truss forming an agreeable appearance of a hand-rail. The beam A B may be made of two pieces, having a certain inclination to each other, and forming such a structure as is given in Fig. 14. Another mode of supporting A B is shewn in Fig. 15. in which F G is supposed to be one-third of A B; and sundry modifications and combinations may be practised with advantage, as is to be seen in Figs. 16. 17. 18. These plans, though very simple, which, indeed, is a great commendation, afford room for skill in the adjustment of the dimensions of timber, and are susceptible of strength and accommodation sufficient for a considerable width. They have been frequently used in Germany, where their durability is promoted by the judicious practice of covering them from the weather by means of wooden roofs. "We have seen," says Dr Robison, "a bridge of 42 feet span, formed of two oak trusses, the biggest timber of which did not exceed six inches square, bearing, with perfect steadiness and safety, a waggon loaded with more than two tons, drawn by four stout horses."—"Another, in the neighbourhood of Stettin, had a carriage road in the middle about 20 feet wide, and on each side a foot-way about five feet wide. The span was not less than 60 feet, and the greatest scantling did not appear to exceed 10 inches by 6. This bridge consisted of four trusses, two of which formed the outside of the bridge, and the other two made the separation between the carriage-road and the two foot-ways."

If the width of the river be too great to be accomplished by one truss, then several trusses may be combined together by simple addition, like the arch-stones of a bridge, as is shewn in Fig. 19. Here the frames A, B, C, D, are to be considered as separate bodies, supported by mutual abutment; but the construction is different from that in which the pieces act, as we have seen, on the principles of carpentry, and in our opinion is inferior to it, though sometimes abundantly serviceable. It may be greatly strengthened by the addition of pieces operating as ties, as already described; in which case, it is very advisable that one of the polygons into which it is divisible should contain the whole abutments, and the other should consist altogether of ties. This may be understood from Fig. 20. in which the polygon A B C D E F, consisting of two layers of beams, (one being supposed too weak,) contains the abutments, and the other, A b c d e F, may be nothing more than an iron rod. The whole has a kind of distant relation to the Norman roof, and this, in fact, may be often rendered a very convenient construction. So much for the general principles. The following descriptions will supply some information as to particular contrivances.

Cæsar's bridge.—Of ancient wooden bridges very scanty relations are found in classical authors. Palladio and others have made drawings from Cæsar's description of the bridge by which he conveyed his army over the Rhine. It seems to have been a clumsy piece of workmanship, formed by the very inartificial mode of driving piles into the bed of the river, and connecting them together by cross-beams and transverse pieces, over which hurdles were placed. It scarcely merits attention in point of science.

To the same writer, Palladio, we are indebted for an account of a much finer structure over the Cismone, a river at the foot of the Alps, which divide Italy from Germany. It is described as a single arch somewhat more than 100 feet wide, entirely suspended by the framing which forms its sides. Palladio has given several plans for wooden bridges, and specifies three ways in which they may be constructed without having posts driven into the water.

Schaffhausen bridge.—A very remarkable wooden bridge was erected across the Rhine, in the canton of Schaffhausen, by a plain uneducated carpenter, named Ulrick Grubenhamm. A stone bridge which had been erected at the same place, having suffered injury from the river, fell in 1754. This man proposed a wooden bridge as a substitute. After some hesitation, natural enough to the managers, the plan was adopted, and executed in 1758. The descriptions given of its dimensions, it is to be regretted, are contradictory, and, unfortunately, the bridge itself is no longer in existence; it was destroyed by the unsparing hands of the French in 1799. Another bridge on the same plan, and built either by the same person or his brother, at Wittengen, also in Switzerland, seems to have been confounded with it. Indeed, the accounts of them are not easily reconciled. The entire length of the former, we are told, was 364 feet (the width of the river being, according to Nicholson, 390 feet,) and its breadth eighteen feet. The artist wished to make only one arch, but was positively enjoined by the magistrates to use one of the remaining piers of the former stone bridge, as an intermediate support. This he so far complied with, as to divide his bridge into two unequal parts, both, we are told, apparently resting on this old pier. Though this bridge, it is said, was able to sustain the greatest loads, yet it would tremble under a single passenger. It is said, moreover, to have been eight feet out of the straight line, having its angle pointing down the river. The distance from this angle to the abutment nearest the town was 171 feet, the other position being 193 feet. From the last mentioned circumstances, it seems that the pier at the angle was really a point of support.

The bridge at Wittengen is reported to have been of one arch, 230 feet wide, and, as such, was still more extraordinary. Professor Robison, writing on the authority of Mr Coxe, who slightly describes this bridge in his Travels in Switzerland, says, the rise was twenty-five feet, certainly low enough for the width, and Mr Nicholson, on the other hand, (why, we do not know,) reduces it to five, which must, we apprehend, be a mistake. The road-way, it is proper to mention, was suspended between two parallel arches, having something of the catenarian curve, and built of seven courses of solid oak logs, in lengths of twelve or fourteen feet, and upwards of sixteen inches thick. The logs, we are further informed, were selected as naturally suited to the intended curve, and were not any way trimmed by cutting across the grain. The same artist and his brother were concerned in the construction of several bridges of this sort.

Wooden bridge in America.—The ingenuity of Grubenhamm, undoubtedly very great, was surpassed by a person of the name of Bludget, who has constructed a wooden bridge over the river Portsmouth, in North America, of one arch, 250 feet span. The principle is an improvement of what has now been described; and so confident was the artist of its strength, after this trial, that he is reported to have said he would trust such an arch of four times the width. It is difficult, indeed, to set limits to such efforts and skill.

Wooden bridges in Britain.—We have no example of wooden bridges in this country worthy to be compared with those now spoken of, at least in respect of magnitude. But from smaller specimens, of equal, if not superior principle, it is not to be doubted that our architects are as able to excel in this as in any other department of the profession. We ought particularly to mention the following specimens: The wooden bridge over the Clyde, at Glasgow, built by Mr Nicholson, and intended only for foot passengers, displays great judgment. It was finished in 1804, and consists of nine openings, each of them 42 feet wide. The river, where it crosses, is 387 feet in breadth. Since its erection this bridge has sustained several very high floods without any way yielding. Its appearance is elegant, and but a small quantity of timber is used in its construction. Somewhat on the same plan is the bridge at Walton-upon-Thames, the production of Mr Etheridge. The centre arch is 130 feet wide and 28 feet in height. There are good examples of wooden bridges between Chelsea

Construction

and Battersea, Fulham and Putney, Brentford and Kew, all over the Thames.

The bridge over the Don, about seven miles from Aberdeen, constructed somewhat differently, by Mr James Burn of Haddington, is highly to be commended. It is 109 feet wide, rather more than 13 feet rise, and 18 in breadth. This ingenious artist has erected bridges on the same principles in other parts of Scotland. As a pattern, we have given a view of the first-mentioned in Plate 14. which the reader, it is believed, will easily comprehend.

Stone bridges.—An interesting history of ancient bridges might be given, but would contribute little to the object we have now in view, the elucidation of important theoretical principles. The Greeks, admitting them to have been acquainted with the nature of an arch, did not apply it to this use. The Romans were more expert in the practice of this art, and have left some monuments of very judicious bridge building. China abounds in them. But we prefer more modern examples, and especially such as have been erected since the art has been cultivated under the qualified influence of mathematical principles. We shall merely mention, therefore, some of the more remarkable ancient bridges, occasionally noticing their most striking features.

Roman bridges.—In Rome and its vicinity were eight bridges, some of which, and the vestiges of others, are still extant under different names.

The bridge built by Trajan across the Danube, which was destroyed by Adrian to prevent the passage of barbarians into the empire, was one of the most magnificent ever erected by the Romans; but the descriptions given of it are somewhat discordant.

The finest bridge, perhaps, that was built by that people in Italy, is said to have been that at Narni, connecting two mountains between which flowed the river Nera. Its whole length was above 600 feet, which was divided into four arches, the largest of which was 142 feet span. The *Pont du Garde*, a Roman structure about nine miles from Nismes, is very remarkable, as serving the double purpose of a bridge over the Gardon, and an aqueduct for supplying Nismes with water. It is described as consisting of three series of arches, one above another, to the height of 190 feet, and is built of very large stones bound together by iron cramps without cement. There is a noble bridge at Lyons, of Roman origin, 800 yards long.

Over the Tagus, at the city of Valenza de Alcantara, about 25 miles from Madrid, is a bridge which was built in the time of the emperor Adrian. This superb work is 670 feet long, divided into six arches, and its height is more than 200 feet.

The bridge on the river Guadiana, in the province of Estremadura, is reported to have 64 arches, and to be 1300 paces in length. Perhaps the largest stone arch in existence is that of the bridge of Brioude, in the lower Auvergne in France, ascribed to the Romans. The span is 181 feet and the height 68 feet.

The bridge of Avignon is of more recent date, having been finished in 1188. It was 1000 yards long, and consisted of 18 arches, some of the ruins of which still remain. An arch of 160 feet span was built at Verona in 1354.

Construction

Modern bridges in Italy.—Italy abounds in bridges of comparatively modern date. The Rialto in Venice, a city which, from its peculiar situation, has more bridges than any other, is rather singular. It is a single arch nearly 100 feet span and only 23 in height. Michael Angelo designed it, and it has always attracted great notice. Its breadth, which is 43 feet, is divided into three small streets, by two rows of shops in the middle, in the center of which is an arched opening where the three streets communicate. Dallaway says, that the most perfect bridge he had seen was one at Florence, of three arches, each 100 feet wide.

In Portugal.—Portugal may boast of its aquæduct bridge, near its capital, as one of the noblest works of the sort ever executed. Its total length is 2464 feet, and it consists of 35 arches, the eighth of which being the largest is 108 feet span and 227 in height. It was finished in 1732, nearly 20 years after its foundation.

In France.—We have elsewhere spoken of some modern French bridges, and have shewn several of their centers. France has many more bridges well deserving of attention. Those of Blois, consisting of 11 arches, the center one being 91 feet span,—of Mantes on the Seine, of three arches, the largest being 128 feet span, and the other two 115 each—and of the Loire at Saumur, which has 12 elliptical arches of 60 feet span each, justly claim this distinction. A bridge mentioned by Mr Nicholson, which is not very unlike the last named, though greater, and erected at Moulins, over the river Allier, and consists of 13 semi-elliptical arches, 64 feet span each, also merits notice.

In Britain.—Great Britain is not defective in this part of architecture. Several bridges of an ancient date testify the exertions of her former inhabitants; and those of modern times may vie with the productions of her neighbours.

The bridge at Croyland in Lincolnshire, supposed to be the oldest structure of the kind in the island, is a singular work. It is formed by the meeting of three segments of a circle in a point, a circumstance imagined to allude to the doctrine of the Trinity, which is not unlikely, considering the period when it was built, viz. about the middle of the ninth century. It is still very sound, and exhibits but few marks of decay.

London bridge, commenced in 1176, required 33 years for its completion. It originally consisted of 20 arches; but two of them were turned into one in 1758. It is a cumbrous building, and is evidently unworthy of the dignified position it maintains. A more suitable companion has been projected for the bridges of Westminster and Blackfriars.

About the same period were built the bridges of Rochester over the Medway, and at Newcastle-upon-Tyne. The former is 550 feet long, consisting of 11 arches. The latter was broken down by a flood in 1771. At Burton-upon-Trent is a bridge erected in the 12th century; it is 1545 feet in length, and is the longest bridge in England. It has 34 arches.

One of the arches of York bridge is 82 feet wide and 27 feet high.

At Winston in the same county, is a single arch bridge nearly 109 feet span. It was built in 1762 for L.500. Llanwst bridge in Denbighshire, was designed by Inigo Jones in 1636. It has three circular arches, the middle one 58 feet span.

The most singular bridge in the island is over the Taaf, in Glamorganshire, executed by a country mason of the name of Edwards. It is a single arch 140 feet span, being the segment of a circle of 175 feet in diameter; its height is 35 feet, and its greatest breadth only 11 feet. In Mr Malkin's *Tour in South Wales* will be found a very interesting history of this extraordinary work.

Of Westminster and Blackfriars bridges over the Thames, certainly the noblest structures of the kind in England, it seems unnecessary to say more. For the sake of comparison it may be merely mentioned, that the former, which was quite completed in 1750, consists of 13 large and two small arches, of a semicircular form, and the middle arch is 76 feet span; and that the latter, which was finished about twenty years afterwards, has nine elliptical arches, and the middle arch is 100 feet span. They are both nearly 44 feet in breadth.

In Plate 14. is exhibited a view of the Strand bridge over the Thames.

A magnificent aquæduct bridge over the Lime, at Lancaster, was constructed by Mr Rennie. It has five arches, of 70 feet span each, is 57 feet in height, and the canal which crosses it admits the navigation of barges of 60 tons burden.

Of bridges in Scotland, the following particularly merit attention.

The Gothic bridge over the Don, near Old Aberdeen, was built in 1281. The arch is 67 feet span, and 34½ in height.

The bridge of Perth, on the Tay, is 906 feet long, divided into nine arches, (besides a land-arch,) the middle one being 77 feet span, and its breadth 26. Mr Smeaton executed it between 1760 and 1771. The same artist, much about the same time, constructed a good bridge over the Tweed at Coldstream, and another over the North Esk, near Montrose, both of them inferior to that at Perth.

The North Bridge at Edinburgh, built by Mr William Mylne about 1770, is remarkable as having no water below it. The full length of this bridge is 1125 feet, but the length of the piers and arches occupies only 310. Its three great arches are about 72 feet span each, and two smaller ones 20 feet. The entire height to the top of the parapet over the center arch is 65 feet, and the breadth about 42 feet. The arches are semicircular, rising 36 feet from the spring. The bridge has a perceptible rise from the middle towards the south end, which, being injudiciously accommodated by the bending parapet, impresses with the notion of the middle arch having yielded, which is not the case.

Kelso Bridge, over the Tweed, constructed by Mr Rennie, has an uncommonly fine appearance, and does great justice both to the artist and the situation. The arches are elliptical, five in number, each being 72 feet span, and the rise 21 feet. The road-way is quite level; and some ornaments of a modest character give no small degree of elegance to the whole bridge.

Near the junction of the Teviot with the Tweed, is a bridge over the former, built by Mr Elliot of Kelso, which has also a fine effect. It is of three arches, the middle one being 65 feet span.

A bridge between Dunbar and Berwick-upon-Tweed, known by the name of Pease, or Peathsbridge, is somewhat singular. It consists of four semicircular arches of different spans, from 48 to 55 feet, crossing a gulley, or hollow, the bottom of which is 124 feet below the surface of the road.

An arch over the Den Burn, at Aberdeen, is the largest in Scotland. It is 130 feet span, and second only, we believe, to that over the Taaf. As originally proposed by Mr Telford, it would have been 150 feet, surpassing any in the kingdom. But prudential motives induced the magistrates of the town to adopt the smaller scale.

At Tongue-land, in Kirkcudbright, is a fine arch, designed by the same able artist, 118 feet span.

A bridge over the Spey, at Fochabers, constructed by Mr G. Burn, has four arches, the two middle ones of which are 95 feet span each.

The bridge at Dunkeld, built a very few years ago, is reckoned the finest in Scotland. It consists of five large arches and two small land ones, the middle of the former being 90 feet span. Somewhat strangely, Mr Telford's claim to the merit of its design and construction has been disputed, and, indeed, publicly denied in the newspapers, by a Mr Brown of Jedburgh. As far as we know, there has been no reply on Mr Telford's part.

Several bridges of various descriptions are either erected, or about to be executed in Scotland, under the management of a board of commissioners appointed by Parliament.

Ireland has but few good bridges. Sarah's bridge, at Dublin, is among the finest. It consists of one arch 110 feet span. Essex bridge, and Carlisle bridge, in the same city, are respectable productions.

Iron-bridges.—Some account of iron bridges will naturally be expected in this place. They are beyond all question of British origin, and hitherto, we believe, have been exclusively constructed in this island. Their use will likely be extended to other countries where the material can be obtained so readily as to render them economical. The principles on which they are formed may be easily understood from a description of the chief examples.

The first iron-bridge was erected at Coalbrookdale, in Shropshire, in 1779, by Mr Abraham Darby, iron-master at that place. It consists of a single arch 100 feet 6 inches span, and is composed of five ribs of three concentric arcs each, which are connected by radiating pieces, and which pass through an upright frame of iron at both ends serving as guides. Plates of cast iron cover these ribs, and sustain the road-way. The weight of iron used in this bridge was 378½ tons. The abutments are of stone. As a first attempt, this is a very meritorious structure; but it is faulty in several respects, and has been surpassed by later efforts.

According to Mr Nicholson, the second iron-bridge

Construction

was cast by order, and agreeably to the design of Mr Thomas Paine, of political notoriety, who intended it for America. As he failed to pay for it when constructed, the manufacturers, who had taken it up to Paddington, near London, employed its malleable iron in the formation of Bishop Wearmouth bridge, near Sunderland.

The iron-bridge at this place, which was erected between 1793 and 1796, under the management of R. Burdon, Esq. assisted by Mr Thomas Wilson as engineer, and Messrs Walker of Rotheram, the founders, consists of a single arch 236 feet in span, 32 in breadth, and 100 feet high from low water. In this bridge, blocks of iron, consisting of a kind of frame-work, were used in place of key-stones, each weighing about 4 cwt. A series of these blocks, to the number of 105, formed a rib, six of which composed the breadth of the bridge. On these were laid diagonal bars, extending to the abutments, to prevent the swerving of the ribs. Cast-iron rings, diminishing in size from the ends towards the middle, fill up the spaces between the arch and the road-way, which consists of a strong timber frame covered with cement and a bed of marle, &c. This magnificent and yet light fabric required 260 tons of cast iron and 46 of wrought iron, and cost L.27,000. Vessels of 200 tons burden can pass below it in full sail, while its strength is sufficient for any incumbent load. A view of it is given in Fig. 9. Pl. 13.

A cast-iron bridge was designed by Mr Telford for Buildwas, on the Severn, and was finished in 1796. It is 130 feet span, and employed $173\frac{1}{7}$ tons of cast iron.

There is one at Staines, over the Thames, considered the neatest and most complete up to the period of its erection. The arch is 181 feet span, and is formed much in the manner of that at Sunderland.

Boston, in Lincolnshire, has an iron bridge 85 feet span.

There are two at Bristol, each of 100 feet span.

Mr Telford designed a bridge for an arm of the sea, between the counties of Ross and Sutherland, in Scotland. The arch is 150 feet span.

We have elsewhere spoken of the proposal of the same engineer for an iron-bridge over the Menai; and we ought to mention, that he proposed another, of no less than 600 feet span, in the room of London bridge. Of the practicability and advantage of such plans, we have not the smallest doubt. Indeed, the almost incompressible nature of the material, the facility with which it can be brought to any desired shape, and the readiness with which it admits of connexion, being considered, in subserviency to the improved principles and matured judgments of such artists as we have named, it would be almost presumptuous to speculate on the probable limits to the practice. The sole difficulty, perhaps, lies in the centering necessary for very stupendous bridges. Time and ingenuity, we are convinced, will overcome this; and new agents, hitherto unthought of, will come to our aid, to falsify the puny conjectures of timid or ignorant men.

Draw-bridges are generally made of wood, sometimes of iron, or of both together, having stone abutments, and are employed on canals, or in fortifications. They are differently constructed. Till lately it was most usual to have them to lift up and let down by means of hinges, and the aid of a kind of balance, operating vertically. But it has been found more convenient to make them turn on a center horizontally, so that the leaf or fold of the bridge is always kept in the same plane. Such bridges are called *swivel* bridges. The best examples are at the West India and London docks. The entrance to the wet dock at Leith affords an example on a small scale.

PART III. OF STYLE, AND THE PRODUCTION OF EFFECT.

Of Style.

Importance of Architecture.—Architecture has been sometimes denominated the chief of the mechanical arts. To this distinction, the important benefits which it confers on mankind, the magnitude of the materials which it employs, and the skill required in its nicer operations, may justly entitle it. The degrees and the manner in which it is practised, form very striking characteristics of the improvement of different countries; and the durability which attaches to its productions has contributed to secure and perpetuate the reputation of people long since vanished from the world. In most of the merely useful arts, the wants of the present generation alone are contemplated and supplied. They minister to individuals, and to circumstances, indeed, which may often occur in the compass of a single life. But the architect, on the contrary, looks into futurity, and provides for the welfare and pleasure of distant ages. His works are destined to abide the judgments of persons yet unborn, any one of whom may have a right to bestow praise or censure equal to that of the original possessor. No wonder, then, that he seeks the establishment of his fame by the adoption of imperishable principles, or endeavours to consecrate it by the authority of laws which are universally recognised. Utility is the first object he aims at, and constitutes, indeed, the only but sufficient excellence of which many buildings can boast. The want of it, we may affirm in general, can be redeemed by no other quality.

Becomes soon ornamental.—But architecture, unless among savage nations, is not long confined to the creation of simply useful edifices. The love of ornament is natural to our species; and, accordingly, human ingenuity seldom stops in the acquisition of mere clothing, or the erection of habitable but uncouth dwellings. Decoration speedily, often immediately follows, and is therefore attempted, and successfully too, in one way or other, by every society of mankind that has emerged from the barbarism of nature. Its kinds are no doubt various and discordant, but the object is the same.

Certain peculiarities in the materials themselves, which have been employed in both of the arts now mentioned, appear to have given the first impulse and gratification to this powerful propensity, and to have served long afterwards as the respected basis of fashion and the guide of taste. Thus the use of skins and fur as ornaments in dress, prevails in the most civilized countries; and the accidental, perhaps the cumbrous appendages of the wooden huts inhabited by the primitive Greeks, are still copied in the practice of the most elegant architecture of modern Europe.

In this art, innovation is indiscriminately condemned. Some monuments of ancient skill, accordingly, which have survived the wreck of time, and the revolutions of the world, and on which, it must be allowed, the mould of age has bestowed a sanctity of character not easily withstood, are held up exclusively as the standard of excellence, from which there can be no appeal to reason or convenience.

From the admiration of ancient architecture have sprung the metaphysical doctrine of "proportions essentially and necessarily beautiful." And "where, asks the student, are these to be found?" "In the Greek orders to be sure," replies the zealous advocate for the doctrine, immediately launching out into extravagant commendations of a few hackneyed examples; "and these orders, (he continues,) have always been admired, always will be admired, and, in short, nothing else can or ought to be admired."

Can it be supposed, that the wretched log-houses of a nation of barbarians have been the precious idols of the *cognoscenti* for some thousand years; that it was held little short of heresy or sacrilege to hesitate in paying them homage; and that it is only in our own days that an individual has publicly dared to dispute their title to such extraordinary veneration? Yet all this is true; and the clear explicit renunciation of so monstrous a delusion, ought to be the preliminary step in any elementary treatise on architecture considered as a fine art.

By such a step, then, we are enabled altogether to exempt a curious and highly interesting subject from the absurdities in which it has commonly been involved, and to avoid the parade of technical rules, and a conceited phraseology, which never failed to perplex the judgments and exhaust the patience of former enquirers. Here we shall avail ourselves of the remarks of a well known critical journal on Mr Alison's Essays on Taste; and this we do the more readily, because it displays those fundamental principles in the essays themselves which are most intimately connected with our present subject, and will consequently furnish the reader with the most important light necessary for its satisfactory investigation.

"There are few things about which men of *virtu* are more apt to rave, than the merits of the Grecian architecture; and most of those who affect an uncommon purity and delicacy of taste, talk of the intrinsic beauty of its proportions as a thing not to be disputed, except by barbarian ignorance and stupidity. Mr Alison, we think, was the first who gave a full and convincing refutation of this mysterious dogma; and while he admits, in the most ample terms, the beauty of the objects in question, has shown, we think, in the clearest manner, that it arises entirely from the combination of the following associations: 1st, That association of utility, convenience, or fitness for the building; 2d, Of security and stability, with a view to the nature of the materials; 3d, Of the skill and power requisite to mould such materials into forms so commodious; 4th, Of magnificence, and splendour, and expense; 5th, Of antiquity; and 6thly, Of Roman and Grecian greatness." "This analysis, (it is added,) is to us perfectly satisfactory. But, indeed, we cannot conceive any more complete refutation of the notion of an intrinsic and inherent beauty in the proportions of the Grecian architecture, than the fact of the admitted beauty of such very opposite proportions in the Gothic. Opposite as they are, however, the great elements of beauty are the same in this style as in the other; the impressions of religious awe, and of chivalrous recollections coming in place of the classical associations which constitute so great a share of the interest of the former. It is well observed by Mr Alison, that the great durability and costliness of the productions of this art, have had the effect, in almost all regions of the world, of rendering their fashion permanent, after it had once attained such a degree of perfection as to fulfil its substantial purposes." "Buildings, (he observes) may last, and are intended to last for centuries. The life of man is very inadequate to the duration of such productions; and the present period of the world, though old with respect to those arts which are employed upon perishable subjects, is yet young in relation to an art which is employed upon so durable materials as those of architecture. Instead of a few years, therefore, centuries must probably pass before such productions demand to be renewed; and, long before that period is elapsed, the sacredness of antiquity is acquired by the subject itself, and a new motive given for the preservation of similar forms. In every country, accordingly, the same effect has taken place; and the same causes which have thus served to produce among us, for so many years, an uniformity of taste with regard to the style of Grecian architecture, have produced also among the nations of the east, for a much longer course of time, a similar uniformity of taste with regard to their ornamental style of architecture, and have perpetuated among them the same forms which were in use among their forefathers, before the Grecian orders were invented." *Edinburgh Review, Vol.* 18.

Chap. I. Of Different Styles of Architecture.

We now proceed to a slight sketch of the styles of architecture alluded to in the preceding remarks, commencing with the Greek orders.

Sect. I. *The Greek Orders.*

The term Order in architecture has been variously defined. It signifies much the same as method, or arrangement, and is applied to such a portion of a certain building as comprehends its entire design. Columns, whether curved or square, these latter being called pilasters, are generally chosen to indicate this design, and, in consequence, the word order has been chiefly appropriated to the arrangement or display of their proportions. It is, in short, a system of the dimensions and ornaments of columns and pilasters, as producing a form capable, for reasons already

Of Style.

assigned, of exciting agreeable or pleasing effect. Differences in these dimensions and ornaments, or, more correctly speaking, differences in the proportions of the parts, constitute various orders, each of which has its peculiar character, and is, consequently, appropriated to a certain purpose or design.

The invention of orders is ascribed to the Greeks, and the language employed to describe their members is borrowed from that people. But certain circumstances would lead to the idea, that the Greeks themselves had been indebted to the Egyptians for some of the fundamental principles of the system. One thing is very clear, that the nature of the orders, whether originally Grecian or not, manifests them to have been the result of observations on the wooden huts of an early people. This can be easily shewn.

Let us form a hut, suppose in a country abounding with wood sufficient for the purpose. The size of the timber will greatly modify the nature of our intended habitation. But we shall imagine that we have it of dimensions capable of affording much strength and security, and that we want a house for the accommodation of a large family. We propose, therefore, to fix a certain number of good sized posts in the ground, at equal distances from one another, so as to form a regular shape, say a square, or other four-sided figure. Within this space we can arrange similar pieces and branches, either resting on the posts or twisted round them. But we are chiefly anxious about a covering at top, to guard us from the rain, &c. to which we are often exposed; and, besides this, our posts, though very secure below, are liable to move a good deal at top, in consequence of having no connecting medium. We must contrive a remedy for the evil, and make a roof. The first step is very simple, and leads us towards the whole of our object. We fix certain pieces longitudinally on the tops of our posts, connecting them firmly together, so that one cannot be moved without affecting the rest. On these again, and across the breadth, or narrower dimensions of the inclosed space, we lay other pieces and probably another row, across these too, for the greater certainty of defence. Still we find that the rain penetrates, and that our roof is incompetent to our wants. It is an obvious suggestion of reason, that certain pieces of wood, or flat stones, meeting in an angle in the middle, and sloping down over the sides of our hut, will carry off the water from it, so that the interior may be kept dry. Thus, then, with various modifications, which peculiar circumstances and views will indicate, we have succeeded in the fabrication of a comfortable abode; and thus, in fact, we have ascertained the origin of those famous orders which are still held as the models of classical architecture, though the materials on which the art now operates are essentially different, and might justly be expected to require another more appropriate treatment. Substitute the term column for post, or tree, and the term entablature for roof, or covering, and the mystery of the orders is disclosed. We shall specify the members into which these parts are divided, and which are common to all the orders, and afterwards take notice of some distinctions in the orders themselves.

The column is divided into two parts, the shaft and the capital, the former meaning the body of the column, from the base or foundation where its rests, to that portion towards the top, where it is usual to have mouldings or ornaments, and to which the name of capital is applied. To these two parts it is now very usual to add a third, viz. the base, though some consider it separately, and subject it also to a certain division.

The entablature, which we may conceive as the roof, or weight to be sustained by the column, is divided into *architrave*, or *epistyle*, that part which rests immediately on the capital; *frieze*, or *zoophorus*, above the architrave, and a little receding from it; and, lastly, the *cornice*, being the upper part which projects beyond the frieze, answering apparently to the jutting ends of the roof, as the architrave does to the lintelling beams, and the frieze to the intermediate crossing ones.

All of these parts both of the column and entablature, we ought to remark, are variously subdivided, as may be seen in Fig. 1. Plate 15. to which we refer as abundantly satisfactory, without occupying more room with verbal descriptions.

Properly speaking, there are only three orders, named from the places where they are conceived to have been invented, the Doric, Ionic, and Corinthian. To these many modern authors add the Tuscan and Composite.

All these orders have the same chief members, and are similarly subdivided. The proportion of their members, the ornaments attached to them, and the destinations for which they are intended, differ in each, as we shall soon explain. But, first, it will be advantageous to the student to give a rule for drawing an order. This we shall take, with some modification, from a small but judicious practical work, by Mr P. Nicholson, entitled the Student's Instructor in drawing and working the five orders of Architecture, which we recommend to his notice.

Rule for drawing an order.—Make a scale of the diameter of the column, as represented in the plate last referred to; divide it into six equal parts, or modules, as they are called, and the first of these into ten equal parts, or minutes. Every member of the order is to be reckoned in minutes of this scale, whether in height or projection, in the following manner. Draw a perpendicular through the middle of the column, on which set off all the heights. Draw another line parallel to this one, at the distance of twenty-five minutes from it, forming the diminution, on which set off the upper projections, as shewn in the figure. Those of the base are to be set off from the outer extremity of the column, which is thirty minutes from the axis. A slight examination of the plate will be sufficient for the understanding of this rule. The names of the mouldings, with their proportions in minutes, are marked on the side of the column. For an account of their varieties, and particular rules for describing them, we refer to the work now mentioned, as more necessary for the student than likely to interest or be valued by the general reader. Most of the practical works treat of this subject with a wearisome minuteness. We shall not add to the number, or occupy any room in specifying the differences of the Greek and Roman proportions of the orders, our object being the most elementary information.

Doric order.—This is the most ancient of the Greek orders, and seems to have been the only one known in Greece till the time of the Macedonian conquest. It bears, more than any of them, perhaps, decisive marks of the common origin of the orders, as may be seen by the peculiarities of its frieze and corners, indicating the joists and rafters of the wooden hut. This will be very plainly discovered in Fig. 2. Originally it seems to have wanted a base, and the columns were often fluted, as if for the convenience of resting the spears with which the early Greeks were in the habit of arming themselves, both circumstances very characteristic of high antiquity. From an examination of many monuments of this order, Mr Nicholson, in his Dictionary, lays down the following remarks as to the proportions of its parts: 'For public buildings the columns may be five diameters (the standard being the diameter of a section of the shaft at the bottom,) or five diameters and a half in height, and for private dwellings, six; the diminution may be one-fourth of the inferior diameter. The height of the capital may be two-fifths of the lower diameter, and may be divided into two equal parts, one of which may be given to the abacus (see the former figure,) the other to the echinus and annulets (that is, the ovolo and fillets of the capital,) the latter may be subdivided into five equal parts, and four of them taken for the echinus, and the remaining one for the annulets. The height of the entablature may also be divided into four equal parts, of which one may be given to the cornice, and the other three being subdivided into two parts, one part may be given to the epistylium, and one to the frieze or zoophorus." It ought to be remarked, however, that the ancients admitted considerable license in determining the proportions. We shall now mention the most distinguishing peculiarities of this order.

The capital consists of a large convex moulding, in the form of a bow, and a square stone, apparently intended to keep off the rain. The architrave, which represents a wooden beam, is formed of a single piece of stone or marble, and is furnished with a projecting band at top. From a small fillet under part of this band, there hang six *guttæ*, in imitation of so many drops of rain, which may be imagined to have proceeded from the *glyphs* or channels in the frieze immediately above. These glyphs, which are three in number, in consequence of which they are generally called *triglyphs*, correspond to cuts supposed to be made in the ends of the beams, for the purpose of draining off the rain, and are formed by two planes meeting internally in a right angle in each of them. The spaces or pannels between these triglyphs, generally of a square shape, are called *metopes*, and are often ornamented with heads of animals and other figures. Over the triglyphs are placed what correspond to the ends of the rafters, denominated *mutules*, one being over each, and one also over each metope. The cornice projects greatly, and its corona usually forms a very well marked distinction between its upper and lower parts. The columns in this order, which diminish from the bottom to the top in a curve or a straight line, are very often fluted in a manner peculiar to itself. The flutes are usually twenty in number, without fillets, and terminate under the annulets of the echinus of the capital. Many examples of Doric are still extant, and have been described in various works. One of the completest, though not the most ancient, is that of the theatre of Marcellus at Rome, described by Sir William Chambers, in his valuable work on Civil Architecture. But the finest specimens are to be sought for in the remains of Greek buildings, as displayed, for instance, in *Stuart's Athens*. In the purest examples, generally speaking, the architrave and frieze are nearly of equal height, each being commonly equal to the upper diameter of the column, and the mean height of the cornice is half the diameter, so that these three parts are to each other in the proportion of 3, 3, and 2; the face of the tablet in which the triglyphs are placed and that of the architrave are in one vertical plane, and the vertical face of the architrave projects beyond the superior diameter, but is retired within the inferior one.

Ionic order.—The Ionic order is next in antiquity to the Doric, and in all probability had its origin in the desire of novelty which so certainly besets a people among whom luxury has commenced. But to what particular object of imitation its capital, by which it is chiefly distinguishable, was conformed, we are not now able to ascertain. Vitruvius, whose authority has been pretty extensively owned, asserts it to have been intended for a representation of the curls in the female head-dress; according to others it is copied from the bark of trees dried in the sun. The forms of certain sea-shells, of the horns of rams, and various other bodies, are also reported to have given the hint.

The divisions of this order are the same as in the former, but the general appearance is lighter and more simple. This is owing to the greater length of the column, which may be stated at 18 modules, that of the Doric being 16, and to the entablature being less encumbered. On the whole, it may be remarked, the parts of this order have not been so strictly defined as the corresponding ones in the Doric, an argument, by the bye, for the notion, that it was more the creature of fancy. The most remarkable peculiarity in the capital is what is called the *volute*, which is easily known by its shape resembling, it is conceived, the curls of the hair as they hang on the right and left sides of the head. The cornice, besides, is characteristic of this order equally with the capital. It represents the ends of the laths to which the tiles were attached, and which are called *dentiles*. But some of the remains of this order, found at Athens, are destitute of these marks. This order has not the triglyphs or mutules of the Doric.

In all the specimens of Greek Ionic, the height of the cornice, measured from the lower edge of the corona upwards, seems to bear a constant proportion to the entire height of the entablature, viz. nearly as 2 to 9. The frieze is wanting in almost all the Asiatic examples of this order. The height of the column has been somewhat increased by the moderns; and in works intended for grand effect, it is usual to make the height of the entablature at least one-fourth that of the column, though in general it amounts to two diameters. See Fig. 3.

Corinthian order.—It is uncertain when this order was invented, but there can be no doubt that it is of much later date than the others we have described. It is remarkable for its delicacy and susceptibility of ornament, characters which have obtained for it the title of *virginal* order, in contradistinction to the Ionic, which, from its greater sedateness and simplicity, has been denominated *matronal*. It is in the capital that the decorations of the order are so conspicuous, and this, according to an ancient report, is said to have been copied from an appearance noticed by an Athenian sculptor in passing the tomb of a young lady. A basket, covered with a tile, had been placed upon it, and round this an Acanthus spread its leaves, the tops of which were bent downwards in the form of volutes, by the resistance of the superincumbent tile. This hint is the commonly reputed origin of the order, and certainly has pretty good claims to be so considered. But it was not in Greece that this order attained the greatest perfection, or was most employed. The Romans excelled in this respect, and in some periods of their history seem to have almost confined their ornamental architecture to it.

According to Vitruvius, the shafts of the Corinthian and Ionic columns have the same symmetry, and the only difference between their entire columns is in the heights of their capitals, the former being the whole diameter of the shaft, and the latter only one-third. He makes the Ionic column eight diameters; the Corinthian, therefore, would be eight diameters and two-thirds. But the moderns have increased it to ten diameters, in which the base and capital are both included. The shaft is usually fluted when the entablature is enriched,—but not when it is formed of variegated marble. The number of flutes and fillets is the same as in the Ionic, generally twenty-four; and the lower parts of the flutes are often filled up with cables to about one-third of their height. In place of cables, some fantastic artists employ flowers, ribbands, &c. but this taste deserves the epithet of vulgar; indeed cables themselves are not quite pure. The Ionic entablature is often applied to this order, but an appropriate one has sometimes been attempted, and a cornice, in particular, is specified as most suitable. It consists of several members, for the due effect of which the whole height of the entablature requires to be increased more than two diameters, making it two-ninths of the columns, whereas, when the Ionic cornice is used, a fifth of the height of the column is sufficient. We cannot help thinking with Mr Nicholson, that this latter is more in proportion to the slight columns of the order.

Sir William Chambers was of opinion that this order was employed by the ancients in temples dedicated to Venus, Flora, Proserpine, &c. "because the flowers, foliage, and volutes, with which it is adorned, seemed well adapted to the delicacy and elegance of such deities." But the Romans do not appear to have restricted it to such purposes, employing it occasionally in temples dedicated to Jupiter, Mars, and Neptune. Indeed it is questionable if the ancients in general were particularly careful to suit the character of the style to the nature or object of the building. We find, in reality, perhaps, all the orders indiscriminately used for all purposes, and on all occasions. See Fig. 4.

The Tuscan and Composite orders, which, from the circumstance of their having been introduced in Italy, are commonly called Roman, may be considered as mere modifications of the three just now described, and require little notice.

Tuscan order.—The Tuscan order has been called *gigantic*, on account of its dimensions and general appearance of strength. It is the simplest of all the orders, having fewest parts and ornaments, and is accordingly used commonly where great weights are supposed to be sustained. No ancient specimens of it, in an entire state, have reached our times, and, in consequence, its proportions, especially those of the entablature, are rather guessed at than accurately determined. Fig. 1. shews the Tuscan.

Composite order.—The Composite order may be said to be compounded of the Ionic and Corinthian. It is rather extensively employed by the moderns—for no other reason that we can discover, than as, from its ambiguous and somewhat undefined character, it allows ample space for the love of novelty. As connected with the orders, we may here mention some other parts of the Greek architecture, before leaving the subject. See Fig. 5.

Pilasters—These are subject to the same rules as columns, from which they differ only in plan, being square or flat in place of round. They are equally suitable for exemplifying the orders, and are similarly distinguished by names. But it is a general opinion, that they are less perfect. As they save room, cost less in construction, and add strength to a building, they are frequently employed either alone or in conjunction with columns.

Attics.—This is a name borrowed from the country of their origin, applied to low square pillars resembling a pedestal, which are placed at the upper parts of buildings as a crown, and generally in order to conceal the roof. Their proportions are not very accurately determined; but it is a pretty common maxim, that their height ought not to exceed one-third of the order on which they are fixed, nor be less than one-fourth.

Colonnade signifies a series of columns, whether separate or connected, used in the support of an entablature, and has its specific name from the number of columns as *tetra-style, octo-style, &c.*

Intercolumniation is the name given to the space between columns. It has been divided into five species, according to the amount of interval, as *pycnostyle*, when the columns were no more than a diameter and a-half from each other, reckoning by the inferior diameter; *systyle*, when at two diameters; *eustyle*, when at two and a quarter; *diastyle*, when at three diameters, and *aræstyle*, when at four, or most thinly set. Other denominations have been applied to the intervals in the Doric order, taken from the

Of Style.

number of the triglyphs which were placed over them, as *monotriglyph* when only one, *ditriglyph* when two, &c. &c.

The term *antæ* denotes a sort of square pillars, which the early Greek architects sometimes placed at the ends of their walls projecting to a considerable distance from the front of the building, so as to form the *vestibulum* or *pronaos* in the case of a temple.

Pediments are ornaments, in imitation, obviously, of the rafters and tie-beam of a wooden hut; a horizontal cornice representing the latter, and two equally inclined pieces, or sometimes more, the former. The moderns seem to have lost sight of this origin, and, accordingly, not unusually commit blunders in the construction of the pediment.

Arcades.—Such is the denomination of certain openings in walls, which, from being too considerable for a lintel, are arched over. They form very good ornaments, and, when well constructed, are stronger than colonnades, for which they are occasionally substituted.

Niche.—The niche is a smaller opening, or recess in a wall, intended for the reception of statues, &c.

The Greeks testified their hatred of the Persians, and their contempt for the inhabitants of Caria, who at one time gave assistance to that people, in a singular manner. They put figures of both under entablatures instead of columns, subjecting them, as it were, to the office of slaves. To these figures the names of *Persians* and *Caryatides* have been applied. Something similar to these are the *Termini*, a kind of half human form, no way more comfortably disposed of. It is not a little strange, that any of the moderns should adopt such perverse absurdities. Extravagant, however, and in the absence of national prejudice, surely unpleasant as this practice is, it illustrates in a very convincing manner what may be held as the only just criterion of the beauty of the orders, their accommodation to the purposes for which they are destined. These figures are evidently put under a burden, aud are conceived as sustaining it. Precisely so do the columns in which the features of the orders are displayed. Their competency to the office is the chief recommendation they can have, and thus Mr Alison's remarks are fully confirmed: "In all the orders," says that writer, "the fitness of the parts to the support of the peculiar weight, or appearance of weight in the entablature, is apparent to every person, and constitutes an undoubted part of the pleasure we receive from them. In the Tuscan, where the entablature is heavier than in the rest, the column and base are proportionally stronger. In the Corinthian, where the entablature is lightest, the column and base are proportionably slighter. In the Doric and Ionic, which are between these extremes, the forms of the column and base are in the same manner proportioned to the reciprocal weights of their entablature, being neither so strong as the one nor so slight as the other. If the beauty of such proportions is altogether independent of fitness, and derived from the immediate constitution of our nature, it is difficult to account for this coincidence; and, as the beauty of fitness in these several cases is universally allowed, it is altogether unphilosophical to substitute other causes for the same effect, until the insufficiency of this cause is clearly pointed out." We shall have evidence of the same truths, in some particulars, in the style we have next to notice. The comparative effects of some of the Greek orders are attempted to be displayed in Plate 16.

Of Style.

Sect. II. *Gothic Architecture.*

The word Gothic seldom fails to summon up notions of stupidity, ignorance, and barbarism. It is very unfortunately applied, therefore, to a style of architecture exhibiting much ingenuity and skill. But no other denomination for it has been generally acquiesced in, and as the inaccuracy of the application in every sense is universally known and admitted, there would be some affectation in any attempt to substitute another in its place.

The architecture so named is that which is to be found in old cathedrals and many other large edifices erected throughout several countries of Europe between the 12th and 16th centuries. It differs widely from the style already described, both in construction and appearance. In the Grecian architecture, the adjustment of materials depended on their strength in large masses, which need only be arranged in neat forms, of simple contrivance. The Gothic, on the contrary, with no other materials than what a Greek artist would have conceived useless, in fact the rubbish and chippings of his work-shop, produced structures of equal strength and perhaps greater magnificence. This triumph over imperfection, it is clear, was not to be obtained without the aid of superior skill that could be called into action in circumstances where the possession of better means superseded the necessity of invention. In appearance, again, this style is easily distinguished by its slender shafts and clustered pillars, its circular, pointed, or angular arches and groins, its spires and pinnacles, and the variety, number, and minuteness of its decorations.

There have been many opinions respecting its origin, all of which have been defended by eminent writers. Those of most note are stated and controverted in a late publication by Sir James Hall. This gentleman, several years ago, excited a great degree of interest by a memoir on the point in dispute, inserted in the 4th volume of the Transactions of the Royal Society of Edinburgh; and the work now alluded to is to be considered as the full elucidation and defence of his earlier speculations. His theory claims the merit of comprehending every part of the style whose origin it undertakes to demonstrate; and, moreover, demands assent, by a direct appeal to history and experiment. We shall not occupy much space in explaining it, as we conceive that a very general view, in addition to some figures, will suffice for such readers as will not be at the pains to examine it more narrowly by a perusal of the splendid work in which it is displayed.

This theory supposes Gothic structures to have been executed in imitation of rustic dwellings made somewhat in the following manner:

In the first place, Let two rows of posts be driven fast into the ground, opposite each other, at an interval equal to that between the posts in the rows themselves, all of them being equal in height to about three of the intervals. Then apply to each post a

Of Style.

set of long flexible rods, thrusting them into the ground at its base and tying them in two places, one a little above the ground, and the other within about a third part of the height, leaving them loose from this point upwards, so that they may be freely moved in any direction. The rods may be three in number to each of the outside corner posts, and five to each of the others, all being placed so as to cover the inside of the posts, and give it the appearance of a bundle of rods. Fig. 6. Plate 15.

"It will be easy now to form the skeleton of a thatched roof. For this purpose, let a rod from each of two opposite posts be bent at its loose tup, so that they may cross each other, as in Fig. 7. which gives us the form of a pointed arch; and the same being done throughout the whole extent of the two opposite rows, a horizontal rod, or ridge-bar, as it is called, being at the same time placed along the points of crossing, we have the appearance of a Gothic arcade. See Fig. 8. Two rods from each post in the same row are now to be treated in like manner, so as to form similar arches in both rows, and these are also to be connected by ridge-bars crossing the longitudinal one. This will be easily understood by examining Fig. 9. without farther description.

We have now employed two rods of each corner post and three of each intermediate one, there still remain one in the former and two in the latter, which we dispose of by causing them to pass diagonally from the corners of each rectangle, not crossing as in the former cases, but applied, side by side, so as to form a continued hoop, or semicircle, as is shewn in Fig. 10.

In this manner all our rods are occupied, and a frame is produced capable of supporting thatch or other covering. "It would seem, however, that, for the sake of strength, the number of rods has been increased in each cluster, by the introduction, between every two of them, of an additional rod, which, rising with them to the roof, still continues its middle position, as they spread asunder, and meets the horizonal pole at an intermediate point. This is shown in Fig. 11. which is drawn with its covering of thatch; and from the imitation of a dwelling so constructed, we may easily trace the three leading characters of Gothic architecture,—the pointed arch, the clustered column, and the branching roof, as exhibited in Fig. 12.

The peculiarities of Gothic windows, doors, spires, &c. are accounted for by the ingenious author on similar principles; and he has actually constructed a small building in this way and with such materials, possessing, in miniature, the features of the Gothic style, and a considerable share of beauty.

The historical evidence adduced, that some such edifices were erected in former times for sacred purposes, will probably influence the judgments of most readers in favour of the theory more than all the acute reasoning and feasible conjectures by which it is supported. But waving every other objection which presents itself to our minds, we shall merely say, before leaving the subject, that this kind of wooden structure, supposed to be the prototype of Gothic architecture, is itself a very complicated piece of work, perhaps too much so for the hasty demands and crude notions of an early people. May it not, then, have been the refined result of attempts to imitate some natural arrangements which afforded shelter to certain primitive generations? A remark, made by Dr Clarke in the course of his travels, will sufficiently point out what we now allude to, and can scarcely fail to yield it some recommendation to the unprejudiced mind. "A building," says that gentleman, in his 2d volume, p. 307. "of considerable, although unknown antiquity, still exists in Rosetta, which seems to afford proof, that the pointed Gothic arch owes its origin to the appearance presented by contiguous palm-trees. The roof is entirely of stone, and consists of curvatures supported by props, representing the trunks of palm-trees, placed in the sides and corners of the structure. Their branches, crossing each other upwards, form intersections corresponding in shape with the pointed arches of our cathedrals." If this notion be correct, it might not be difficult to reconcile the theory with some of the opinions intended to be supplanted by it.

The pointed arch, we ought to observe, is not essential to Gothic architecture. This leads us to notice two species of building to which that very improper title has been applied, both of them to be found in Great Britain, a country abounding in some of the finest specimens of the style. These species have been denominated, by some authors whom we follow here, Saxon and Norman, certainly with some degree of accuracy, if the circumstance of peculiar and almost exclusive adoption by the people so called be allowed to warrant a national appellation.

The Saxon style, or that which prevailed in England before the conquest, but by no means confined to it, and which has been sppposed an adulteration or rude imitation of the genuine Grecian or Roman manner, is characterised by circular arches, such undoubtedly as may be seen in the remains of ancient buildings in Rome, round-headed windows, and massy pillars, also round, and having a sort of regular capital and base. In this style most of the old English churches were built, many of them exhibiting great art, and being productive of very fine effect. A few examples will prove this. In Fig. 13. Plate 15. which represents the arched entrance to the north aisle of the nave of Peterborough cathedral, we have an excellent specimen of Saxon capitals, and of what has been called *chevron-work*, or zig-zag ornaments, often found in Saxon buildings. Fig. 14. same Plate, exhibits one of the arches in the upper walk in the nave of Norwich cathedral. It has what is known by the name of *billet*-moulding, and one of the columns has a spiral band. The window, it will be seen, is in a different style, being pointed, and is of later date. A tower, on the east side of Norwich castle, of great but unknown antiquity, is a beautiful illustration of this style. We have a still nobler example in Durham cathedral, which is in the purest Saxon manner.

The Norman style is distinguished by the pointed arch, and may be considered as that from which the Saxon received its greatest degree of beauty and perfection. It is to this style, particularly, though, as we have already shewn, improperly and inadequately, that the term Gothic has been assigned. It has been divided into the *absolute*, the *ornamental*, and the *florid*; but such distinctions, though no doubt capable of being proved to exist, are of comparatively little moment in a general point of view, and need not occupy our attention in this place. We shall equally disregard the division into 1st, 2d, and 3d orders, which Dr Milner and others have adopted.

The author last mentioned has exhibited, in a series of drawings, mostly taken from Winchester cathedral, the probable rise and progress of the pointed arch. The selection we have made from his work will not prove uninteresting, and may serve instead of verbal description. See Fig. 13.—17. Plate 15. To these instructive drawings, he has added a view of Westminster Abbey, as a good example of the pointed style, contrasted with Durham cathedral, as a specimen of the circular. For particular information on the subjects now cursorily mentioned, we might refer to an immensity of different publications, by which, in various ways, and on various principles, it has been lately attempted to render justice to the skill and taste of our ancestors. It will be enough, perhaps, to specify a Collection of Essays on Gothic Architecture by Warton, Bentham, Grose, and Milner, the 3d edition of which was published at London in 1808; and Dallaway's Observations on English Architecture, London, 1806, in which sufficient references will be found to other valuable productions.

Gothic architecture, originally employed, almost exclusively, in sacred edifices, has, in modern times, been applied either alone, or with various combinations, to the construction of private dwellings. It is questionable if the practice have any advantageous associations to recommend it; and it is very certain, that few instances in which it has been adopted have succeeded in yielding satisfaction as objects of taste. Admitting that they are equally well executed with some ancient structures, still the interest of age is wanting to give them similar effect. But, unfortunately, this admission is not reconcileable with the real condition of most of the modern fabrics denominated Gothic. This term, indeed, seems at last to have obtained in them a suitable exemplar of its common acceptation, and will therefore be continued in general use, we have no doubt, for a century or two longer. To this new application we can have no objections; but then there is the greater necessity for finding another expression to denote the objects which are so miserably burlesqued!

Sect. III. *Of the Egyptian and Oriental Styles.*

We ought not to close the subject of style without making a few remarks on the peculiarities of architecture in some countries which have furnished occasional modes for imitation to the inhabitants of modern Europe. The whole may be classed under two heads, Egyptian and Oriental styles, the latter being divisible into Persian, Chinese, and Indian; to which we may add the Moorish or Saracenic.

Egyptian style.—This can only be ascertained from an examination of ancient structures, the affairs of Egypt having long precluded any attention to this art beyond what is requisite for essential utility. As far as can be discovered, the architecture of Egypt is original, that is to say, unborrowed from the practice of any other country. It is of the greatest antiquity; and some of its monuments still constitute the wonders of the world. The striking features of the style may be said to be massiveness, sameness, tapering walls, huge pillars, flat roofs, and emblematical sculptures. Few and feeble attempts have ever been made to introduce this style into modern practice. Several of its most glaring appearances have of late imposed themselves on public taste in the shape of furniture.

Indian style.—Several resemblances have been noticed between certain buildings in India and Egypt, and hence an argument, in conjunction with other circumstances, for the opinion maintained by very respectable authors, that an intercourse between the two people had formerly existed. It is chiefly in the religious edifices of India that we discover the peculiarities of its architecture, superstition having preserved a partiality for the forms and decorations of early times, whilst political revolutions have proved unfriendly to the cultivation of other branches of the art. The pagodas or temples are of five different kinds: 1. Excavations; 2. Pyramids; 3. Courts of a square or oblong form; 4. In the shape of a cross; 5. Those that are circular.

The excavations are very numerous, and sometimes of immense extent. They are cut in mountains and rocks, and are either plain or enriched with sculptures and statues. The roofs of these singular structures are sometimes flat, and sometimes in the form of an arch, and are occasionally supported by pillars. In the size, the labour requisite for construction, and the general effect they are capable of producing, some of these excavations may vie with the chief productions of art in any part of the world. Those of Elephanta and Salsette, islands near Bombay, and of Vellore, situate 18 miles from the capital of the province of Balagat, are conceived to be the most remarkable.

The pyramids are constructed of large stones, and are rather of a rude appearance. They have narrow entrances and are lighted with lamps.

The most considerable pagoda of the third kind is that of Seringham near Tritchinopoly. It is four miles in circumference, and is composed of seven square inclosures, one within another, the walls of each being 25 feet high, and four feet thick. The outward wall is ornamented with pillars, and the gateways are covered with emblematical figures. Similar edifices are common in India.

At Benares, on the banks of the Ganges, is a noted temple in the form of a cross. The branches are of equal length, and there is a cupola in the middle, under which is an altar sacred to Hindoo mysteries.

Juggernaut is an example of a circular pagoda, several particulars of which must be familiar to most of our readers, from the general attention excited about it by the publication of Dr Buchanan's *Christian Researches*.

Of Style.

The domestic architecture of India presents little interest. We know of no instance in which it has been copied in our regions.

Persian style.—The ancient architecture of Persia, unlike that of Egypt and India, was directed to civil rather than religious purposes. Accordingly, their cities, palaces, and we may add tombs, have been often spoken of in terms of admiration, whilst their temples, that of Belus and a few others excepted, do not seem to have gained much notice. The Persian style has some traces of the Egyptian, the Indian, and the Grecian; and in other respects, again, is somewhat peculiar. The religious edifices which have been erected in this kingdom in modern times, bear strong resemblances to the usual style of Turkish mosques, abounding in domes, minarets or tall slender pillars, squares, &c.

Chinese style.—Very different from any of the styles we have mentioned, is that which prevails in China. It has every mark of originality, and in all probability is directly deduced from the tent. Its form, proportions, and constituent parts, all indicate this early habitation as its prototype. The nature of the government in that country, and the prejudices of the people, have opposed any innovation on their style, and accordingly, almost every species of building exhibits the same general features. It is in the gateways of their cities, and their triumphal arches, which are numerous, that any thing like variety is to be found. Regularity, lightness, and a certain expression of gaiety, are its chief recommendations. Of sublimity, or grandeur, or strength, it can scarcely be said to possess any marks whatever, even on the largest scale on which it is displayed. On the whole, many of its characteristics, with sundry modifications no doubt, may be very judiciously, and with good effect, introduced into our own *country*. They are most suitable to the villa and ornamented cottage.

The *Saracenic*, *Arabian*, or *Moorish style*, if such it may be called, bears some resemblance both to the Egyptian and the Grecian, and probably, indeed, is the result of an attempt made to combine these two together. The finest examples of it are met with in Spain, as the palace of the Alhambra, and the mosque at Cordova, which have been so splendidly illustrated by an ingenious and erudite author, Mr Murphy, whose late work on these remains is perhaps the most magnificent addition to the library of the arts that has been made for half a century. In general effect, judging as we do from this gentleman's drawings, we should imagine that some of these specimens, as the Halls of the Two Sisters, of the Ambassadors, of the Lions, &c. surpass every architectural display that is elsewhere to be met with. This is another, and perhaps decisive evidence, of the truth of our preliminary observations; for it is certain, that in these very examples great departures from what is called *pure taste* may be pointed out. Those who are interested in scenic representations for the theatre could not possibly do better, we should think, than avail themselves of the gorgeous and impressive beauties presented in the superb publication just now mentioned.

Chap. II. Of the Characters of different Kinds of Buildings.

Of Style.

Architecture, we have seen, is both a practical science and a fine art. The former, which is of most importance to human welfare, is the result of observations and experiments on the properties of bodies, and can scarcely be said, notwithstanding the rapidity of its growth, and the perpetual necessity for its exercise, to have attained the perfection of which it is susceptible. The latter, though it has its origin in certain affections of the mind, is and can only be cultivated where civilization and refinement of policy permit a considerable portion of a community to be occupied in devising gratifications for the superinduced desires of the rest. Like the other arts of taste, it is liable to be influenced by the prevalent sentiments and actual condition of society. In some countries, accordingly, where luxury most prevails, there is ground to fear it already hastens towards that state of corruption, from which there seems scarcely a possibility of escape for any thing of human contrivance. The progress of the arts of taste, indeed, has been pretty uniform among very different nations. Simplicity of appearance, and modesty of design, are succeeded by ambitious combinations and conceited artifices; grandeur of effect, and majesty of manner, give place to ostentatious embellishments and useless pageantry. If there be the least hope that architecture shall have another fate, or a more protracted declension, in our times, it must be founded on the prevalence of scientific information enabling great numbers of persons to correct the extravagancies of taste, by frequent appeals to recognised principles of utility. Very fortunately, there is always a sufficient excuse for such appeals, because, as the productions of the art are intended for something else than merely to give pleasure, it is necessary that certain persons should explore the intelligence of the artist, and sit in judgment on his reasons for the conduct he adopts. Their decisions, therefore, are calculated to maintain the authority of laws which are much more respectable than the arbitrary decrees of fashion. The labours of one philosopher, it may be added, incidentally directed towards the metaphysical basis of this art, as we have already mentioned, have gone far to rescue it from a no less hurtful, and, perhaps, more insidious influence. Much still remains to be done for its prosperity; and its fate must ever be held as doubtful, till the extension of science has presented legitimate inducements for the exercise of genius, and an enlarged acquaintance with the fundamental principles of sound criticism shall have lessened men's regard for the imposing, but idle maxims of the schools.

The following remarks on the characters of some kinds of buildings, may not be altogether unacceptable to the liberal-minded reader, as a small but unhesitating attempt to divest the subject of pedantry, and bring it more directly under the cognizance of common sense and feelings than has usually been its fortune to experience. A few observations of a practical nature are occasionally blended with them, which may not at first sight seem quite well placed; but there is a necessity for recurring at times to the primary sources whence the decisions of taste are derived; and we have contrived to avoid repetition, which is less pardonable, by deferring their insertion to this place. We cannot undertake to treat of all the classes of buildings, and have accordingly selected such examples as appeared most susceptible of useful discussion, or more immediately concerned the interests of our readers. We propose, therefore, to treat, 1. Of the Cottage; 2. Of Farm-houses; 3. Of the Villa; 4. Of Grouped Houses; 5. Of Public Buildings. Our observations, we conceive it very necessary to mention, are in great degree the result of our careful perusal of numerous books on the various subjects treated of, some of which we have occasionally specified as more particularly calculated to assist such persons as are interested to prosecute the investigation farther.

Sect. I. *Of the Cottage.*

What is a cottage? There is some difficulty in answering this question. According to Dr Johnson, whose authority may be considered as decisive, it is "a mean habitation." But the word mean is a relative term, and, in the present application, has undoubtedly a reference to a higher or more dignified order of building with which the cottage is compared. The greater house, it is evident, must be supposed to exist in the neighbourhood, or, at least, to be well known by the persons who use the phrase. To an inhabitant of New Holland, it is probable, a moderately neat English hut would appear a superb mansion; and, on the other hand, to a person who had been accustomed exclusively to the elegance of a modern European city, most of the plain though comfortable houses of our farmers might seem to deserve the title of "mean habitations." The definition, then, is a very loose one, and can scarcely be employed without ambiguity or inaccuracy. To deduce an answer from the rank of the person that inhabits a place so called, would be no less unfortunate. The peasant is not its only occupier. Farmers, noblemen, and princes have their cottages, as well as the hedger or ditcher. We must restrict the term, therefore, to something characteristic of the building, if we wish to avoid mistake and to be generally understood. Perfect accuracy in the adaptation of words can scarcely be looked for in this case, and perhaps every reader has attached some peculiar idea to the term. Yet surely there is a common principle regarded in the minds of all who use it. We propose to confine its acceptation to those comfortable country habitations, whatever their form or materials may be, which are of humble size, and unconnected not only with other dwellings, but also with distant outhouses, such as stables, barns, &c. The propriety of this last restriction will be apparent when we come to treat of farm-houses and villas. After all, the term will be found abundantly comprehensive, as including not only the dwellings of the country labourer or farm-servant, but also lodges for gates, hunting-boxes, hermitages, retreats, &c.

The cottage is evidently intended for economy, ease, and convenience. It is remote alike from every idea of expense, grandeur, and danger. It has nothing to do with the circumstances of feudal times, and may be considered as entirely the offspring of improvement and peace. Every thing, therefore, in its appearance, where choice can operate in its creation, ought to correspond with its humble but secure character. But even the lowest examples of this class of buildings have a powerful effect in determining the features of a country, much more indeed, from their number, and the very circumstance of their being destined to accommodate the bulk of the people, than the ambitious and repulsive castles and palaces which are but occasionally met with in a wide sphere. Gentlemen of property would do well to attend to this influence when laying out their estates. Let them never forget, that the rustic beauty of the cottage is one of the finest objects in a landscape, and that the impressions which the mind of a spectator receives from it, are vastly more in unison with enjoyment than any that are obtruded by vast masses of stones, however elegantly or scientifically adjusted. Independent, therefore, of humanity, good taste will suggest some solicitude in the position and structure of the cottage. Nor are there wanting motives of policy to enforce its dictates. The laborious inhabitant of a neat and comfortable cottage, it is certain, will never be without a strong inducement to promote his master's welfare, as conducive to the preservation of his own advantages. We shall give a few directions as to the management of buildings of this class.

Peasant's house.—Every man, having it in his power, would fix on a situation for the abode of his peasantry which seemed to be healthy and to promise comfort. If consistent with the improvement of the prospect and scenery round the principal mansion, though at a respectful distance, the situation is so far to be preferred. A remote hill or rising ground is pleasingly ornamented with a neat cottage or two, especially if their colour have as much liveliness as is compatible with modesty. So sensible are many persons of this, that it is not unusual to plant grotesque and homely fabrics in such situations, though without intending them to be inhabited. These have undoubtedly a good effect, but certainly the animation of children seen at play from a distance, or even the occasional appearance of supported age, awakens an interest of superior excellence. If a valley be chosen for the situation of a cottage, it is adviseable to select a spot of ground that rises somewhat above the rest, and the floor ought to be sufficiently elevated to admit of a drain for the water from the eaves, which is apt to destroy the foundation, besides rendering the dwelling damp, and, of course, unhealthy. It is really painful to see the evil effects of neglecting so obvious a principle as that of raising the floor above the ground, which in general can be accomplished at an expense no way proportioned to the advantages. A cottage on the side of a road requires to be somewhat elevated for another reason; the road itself, in course of time, becomes more raised than it originally was, owing to the accumulation of materials added to it for the purpose of repair.

The addition of a garden is a striking improvement in point of effect and convenience. It is in general better placed in the rear, or to one side of the cottage than in the front, where an inviting and unembarrassed aspect is expected. But an oak tree, a thorn bush, or other umbrageous shelter, is reconcileable with the first and most pleasingly entertained impressions.

The materials for cottages must generally be those which the country most readily affords. In some places we find wood abundant, in others stone is more plentiful; occasionally we must content ourselves with turf or clay, both of which, as has been mentioned, may be rendered subservient to every ordinary purpose. Where brick earth can be had we readily obtain a most useful building substance. Wood enclosures filled in with bricks between the quarters, constituting what is denominated brick-nogging, may be found thrifty and very convenient. If stones are used, the expence of polishing them is highly unnecessary, even where saving is not enjoined by economical considerations, as in the rough state they correspond best with the nature of the intended fabric. The choice of stone, where there is a variety, must be determined by the general principles elsewhere treated of as applicable to particular cases. Bricks are commonly of a fiery red colour, which is offensive to the eye. But this can be easily modified, as we shall immediately mention. The roughest bricks are perhaps the most serviceable in cottage building. A very material saving in them may be made, by leaving the walls hollow, which in slight fabrics of this sort are abundantly secure. They have the important advantage besides, contrary to what might be imagined, of being remarkably warm, as the air included between the shells is a bad conductor of heat. The vacancy may be filled up with gravel, mixed with quick lime and water, of the consistency of whitewash, which will much encrease the strength and durability of the building. Thus a wall fourteen inches thick, for example, may be constructed with the breadth of two bricks, each being four inches in width, having a cavity of six inches in the middle, to be filled up in the way now mentioned, or to be left unoccupied, except by the horizontal and vertical ties requisite for the due connection and stability of the materials. Such a structure, it is very evident, will present a much better opportunity for the judicious adjustment of doors and windows than the common plan, which, by making the walls narrow, requires the frames of both to be nearly on a level with the external surface. This has a flat dull appearance, and the outside window-shutters, which are a very usual accompaniment of it, are still farther destructive of good effect. For this suggestion we are indebted to Mr William Atkinson, whose views of picturesque cottages, published at London in 1805, may be profitably consulted by the reader.

The colour of cottages is not unimportant. Where beauty is easily attainable, or deformity can be conveniently avoided, want of solicitude is at least no virtue. There are several ways of colouring walls. Thus a good wash may be made of lime, in which wet gravel is mixed; where the building is plastered and rough cast, pebbles mixed with lime give it an agreeable broken colour. Lamp or ivory black, a preparation of charcoal, yellow ochre, and various other substances, may be used with lime for the purpose of changing its hue. Lime, or whiting, and some of these colouring substances, mixed with the liquor of boiled lintseed, or the serum of blood, has been recommended with similar intention. Perhaps a light clay or stone colour, not over white, is the fittest for the rural dwelling. Fantastic colours are vulgar and incongruous; red is positively offensive; white hurts the eye, and forms too great a contrast with the adjoining verdure.

Coverings of cottages.—The coverings for cottages may be slates, either blue or grey; tiles differently coloured and shaped; reeds, and thatch. Almost every consideration of comfort, convenience, suitableness, prejudice attaches to the last named material. The chief objection to it is its greater liability to take fire from the sparks of the chimney. But accidents of this kind occur so seldom as scarcely to require a thought.

Thatch is no doubt often dearer than either tiles, slates, or flag stones, which latter are sometimes but owing to their weight very improperly substituted for them. Economy, then, may demand one of these materials. But where thatch can be had more easily, or at the same expence, we should not hesitate to employ it. Let it be laid on in a simple manner, so that it may be readily repaired; its edges ought to be cut smooth, but not too close; and the eaves are to be made to project and overhang a good deal, so as to throw off the water from the foundation. Indeed, with this intention, and as yielding both an agreeable shade and a picturesque appearance, the Chinese snout, as it may be called, is much to be commended. Perhaps nothing more disfigures a house than the opposite of this plan, the bald timid eave which shrinks within the walls. Reeds are a good substitute for thatch, where they can be procured. We have no doubt that other substances might be occasionally used with success, for example willow wands, whins, broom, heather, &c. Grey slate has a pleasing appearance, but is commonly too heavy. Blue slate forms a very unhappy cottage roof, no way harmonizing with the character. The tile, from association of ideas, perhaps answers better. But the red one is very obtrusive, though frequently used. When reduced, as it may be, to a sort of grey colour, the effect is much more congenial. For this purpose, they may be treated with quicklime, sand, and soot, mixed together. A brown colour, which many prefer, is obtained by washing them, before they are burnt, with a solution of the black oxide of manganese. Glazing tiles by means of lead, is most injurious to fine effect.

Windows of cottages.—On the subject of cottage-windows much may be said, because much has been said. People will undoubtedly please themselves when they have the means of gratification, and therefore it seems superfluous to give advice. A word or two may not, however, be altogether thrown away. When simplicity is a constituent of the general character, it is surely most erroneous to introduce any thing under the plea of ornament, which, in any circumstances, would deserve the name of affectation. A form, pleasing enough in itself, or rendered so by some association of ideas, becomes really disagree-

Of Style.

able when it suggests incongruity. Besides the first impression, though, by surprising, it may give delight, is soon lost in the conviction of judgment that follows, and then the taste of the owner and planner is disparaged for ever. Venetian, Gothic, and grotesque windows, are all unsuitable for the simple cottage, though appropriate it may be to a variety of whimsical structures assuming that title. An ancient building, whatever its form or fashion may be, produces an emotion allied to pleasure. But new houses, with old names, expose the absurdity of the contriver. Equally unhappy is the attempt to engraft dignity, or splendour, or solemnity on the thatched dwelling. Finesse and tricks of every kind must not only be discarded but despised. It must have a plain, honest face, without pretensions and without vanity. Rectangular openings, of one, two, or more compartments, supplied with moderately sized panes, or the small-diced glass, as indicative of moderation and economy, answer every purpose of a window, without the possibility of being misconstrued or giving offence.

Form of cottages.—A question has long been agitated, Ought regularity or irregularity to prevail in the form of the cottage? On abstract principles, perhaps, this neither can nor ought to be answered. Regularity is certainly pleasing; irregularirity, on the other hand, implies a degree of ease, the expression of which is agreeable both to ordinary feelings and the design of a cottage. Regularity often becomes stiff; its opposite runs the risque of caprice. The size and situation of the cottage require to influence the decision between them. A very small cottage claims the advantage of regularity to ensure respect. One of larger size may dispense with it, and seek with success the approbation of variety. Uniformity and flatness are unfriendly to picturesque cottages. Numerous broken lines imply stupidity and carelessness, where the subject from its smallness, seems the product of one man and a day.

It is out of our power to give particular plans of cottages, or to lay down rules for the allotment of the various appendages, such as dairy, wash, or brewhouse, piggery, &c. &c. These, of course, are as various as the whims and tastes of professional men and amateurs. We conceive it better to treat of the general principles, with a view to the promotion of comfort and neatness in this very interesting branch of architecture.

Lodge.—The description of the lodge is introduced under this title for various reasons. The only remarks which we deem it useful to mention with respect to it, in addition to what has been already said, are the following: The lodge having a reference marked and well known to the mansion or villa, seems to require at least a character in alliance with it. There can scarcely be a more glaring error than that of making them of opposite or irreconcileable architecture; for example, the house Gothic, and the lodge in the form of a Chinese pagoda; or the former castellated, and the latter pure Grecian. There is no reason whatever for such incongruities; nor, on the other hand, would a perfect but diminutive resemblance be a recommendation. These extremes are easily avoided, and the general principles for the construction of cottages admit of perfect modification to any style of architecture which the chief building may assume. See Lugar's Architectural Sketches for Cottages, &c. Lond. 1805; also Gandy's Designs for Cottages, &c. published at the same time and place; Miller's Country Gentleman's Architect, published in 1810, affords a still greater variety of examples.

Of Style.

Cabâne ornée, or ornamented cottage, a creature of the present times, may either be treated of here or under the head of Villa. Much of what we have already said applies to it. Though admitting, as the name imports, the introduction of something more than is requisite for comfort, yet as one of the most judicious writers on the subject, Mr Pococke, (Archit. Designs for Rustic Cottages, &c. Lond. 1807,) remarks, the various decorations employed in it ought to avoid the appearance of ornament, unless calculated at the same time for some useful purpose, or the more effectual display of natural beauties. Thus the *veranda* yields a shade from the south-west sun; the *trillis* supports the tendrils of the vine, &c.; the porch covers the entrance; a pleasure-ground, shrubbery, water-pond, &c. contribute various advantages for health, recreation, and convenience.

We hold it quite unnecessary to say a word about *hunting-boxes, pheasantries, hermitages*, or any other of the *grotesque* fraternity. They can scarcely be said to be reducible to rule; and perhaps, indeed, if they were so, they would entirely lose their charms in the opinions of those who admire them. It is enough to refer to Mr William Wrighte's treatise on the subject, where the most erratic fancy may meet with ample materials for its operations.

Sect. II. *Of Farm-Houses.*

It is scarcely necessary to say that any house may be called a farm-house which is inhabited by a farmer, and has the usual conveniences around it, for the preservation of grain, and the protection of animals. Necessity converts cottages and common houses of every description into farm-houses. We do not profess to take cognizance of such cases, although some of the following remarks may aid in the filling up of yards with the requisite offices, where economy is imperatively enjoined. Our concern must chiefly be with those persons who find it practicable to consult comfort, and a certain degree of taste, in the erection of agricultural buildings. So much of human happiness, on the largest scale of the expression, depends on the prosperity of the husbandman, that an unusual degree of interest attaches to his accommodation. But it is obvious that the mere construction of his own dwelling ought to occupy us very little after what has already been delivered on the subject of cottages, the better kinds of which, it is certain, with the addition of out-houses, &c. may be adapted to every condition of the operative farmer. A higher class, that of the gentleman-farmer, seems to demand, indeed, some peculiar attention; and as the ambition of most persons engaged in the profession of agriculture is to rise to that rank, we can scarcely avoid the introduction of some advice and plans calculated to secure the advantages aspired after.

Of Style.

Substantial importance, and an expression of compactness and security, ought to characterise the farm-house. Beauty it may have, but the affectation of elegance is preposterous. This will be easily understood, when it is considered that even cleanliness is not unusually an excellence of difficult attainment. There is something in reality peculiarly disgusting in the frippery and nonsense with which many persons in this profession, of little taste and less judgment, attempt the imitation of their betters. But the spirit that leads a farmer to equal, if not to surpass his landlord, in the appearance of his house and grounds, justly subjects him to a high penalty, the depreciation of his good sense.

The situation is a matter of extreme consequence; regard must be had to a variety of circumstances in fixing it, as the size and form of the lands, the nature of the farm, whether arable or grazing, or both, the position of woods and rivers, the existence of hills or valleys, the direction of roads, &c. &c. These require the nicest consideration, and, in difficult cases, the employment of very intelligent and experienced men. The house, in general, ought to have an unembarrassed prospect, commanding as much as possible of the country. For the same reason, the stack-yard requires to be placed so as not to interrupt the view, and eminences of every kind are to be subjected to the supreme controul. Low shrubberies are quite allowable, but plantations of trees, lawns studded with lofty elms, &c. are at variance with the fundamental principle; much more so are conspicuous hot-houses, elevated dove-cots, and presumptuous summer-houses. These belong to a higher, but, in fact, less important architecture. The size and nature of the family will point out the most essential distribution and magnitude of the rooms. Commonly, it is believed, provided the situation be a lofty one, and the foundation be circumspectly laid, it will be found most convenient to have all the house on one flat. But a room or two above, for occasional retirement and strangers, may be in the list of desireable objects. Best and common parlour, lodging-rooms, kitchen, pantry, and store-room, complete the necessary *morale* of the house itself; dairy, brew-house, &c. &c. which are no less essential, are parts of the outward distribution. The common sitting-room is to be considered, in some degree, in the light of a sentry-box, having a command of all the premises. To perform this office the better, a pretty large and rather projecting window is an advantage. A farmer, like a prudent general in an enemy's country, will always have his eyes in his head, as the proverb goes, and a spy-glass is not a superfluous companion of either! In a single house, this room may occupy an entire breadth; being necessarily, therefore, of considerable size, it admits of all the petty conveniencies of presses, recesses, &c. essential for common purposes. A double house must be so laid out, in reference to the plan of the whole concern, that easy inspection of what is important may be attained. Where there are wings to a house, and the use of them is often expedient, we accomplish the same end, as in the first case, by devoting one of them to the family sitting-room. In our judgment, regularity of plan, however pleasing, is the very reverse of being most conducive to the object of a farm-house; and, besides, when we consider that it is discoverable from *one* point only, we think very little is lost by sacrificing it, even if no other arrangement secured pleasing effect, which is very far indeed from being the truth.

Of Style.

A farm-yard ought to have an easy access from the roads, be well sheltered, plentifully supplied with water, stand somewhat elevated, and present a sufficient extent of surface for commodious outlay. The ground intended for it should be levelled, and, if requisite, be supplied with chalk or clay, in order to prevent the absorption of moisture, so necessary for the due preparation of manure. The buildings ought to be above the level of the bottom, so as to admit of sufficient drains towards the receptacle of the litter. The out-houses most connected with domestic concerns are to be placed nearest the dwelling, and, in general, the distinct branches of the whole economy ought to have corresponding separations, in order to prevent confusion.

To Middleton's Views for Farm-houses, &c. Lond. 1795, Lugar's Country Gentleman's Architect, Lond. 1807, and other works of professional men, we must refer our readers for a variety of specific plans. The last publication, just now mentioned, has some judicious remarks on the subjects of Dairies, Barns, Dog-kennels, Poultry-yard, Piggeries, Malting-house, Brew-house, &c. The first volume of the Communications to the Board of Agriculture may be advantageously consulted for observations on farm-buildings.

SECT. III. *Of the Villa.*

Here we abandon ourselves entirely to fancy and the thousand conceits which caprice and affluence may suggest. The villa is a gentleman's house. Let him submit himself to no law but that of his ability, profess regard to no authority but his own taste in its creation. To say that he ought to do this or that, to adopt the Grecian or Roman model, entomb himself in a Gothic abbey, set the world at defiance by towers and moats and castellated walls, or court adoration in a Mahommedan mosque, would be regarded as idle officiousness. The villa may be in any style of architecture. It may emulate the splendour of the palace, condescend to the lowly cottage, or wanton in every irregularity of design and object. It remains to be said, whether in doing one or other it be beautiful, romantic, or deformed, and in what degree it is so.

In the first place, then, a mansion that receives no embellishment from the surrounding scenery, often claims more exclusive applause than it is entitled to. A distinction ought to be made between a country house and a town house; but the former appellation is quite misapplied if it present nothing but stone and glass to notice. We wish to contemplate nature, wild or improved,—the sloping hill and variegated lawn,—the poetry, if not the sublimity of wood and water.

Secondly, The style of this building ought to correspond with the situation. The venerable Gothic is ridiculed by adjoining gaiety—a castle is sunk to insignificance when planted in a valley,—perfect regularity of architecture, especially if highly ornamented, upbraids the careless freedom of nature seen in her wildest forms,—in short, a degree of suitableness between style and situation is essential to harmonious effect. Even the circumstance of relative distance from a large town, or the peculiarity of the country, on the large scale, insinuates itself at last into our conceptions of this quality. We do not look for a *new* fortress within a mile or two of London, nor for a *Roman* palace in the Highlands of Scotland. It is vain to answer, that this is an arbitrary mode of judging, founded on prejudice and not on reason. Be it so. But what, we ask, has reason to do with a thousand other impressions which external objects make upon us? The fact is, we are so and so constituted as to be thus operated on, and all the arguments and demonstrations of an Aristotle would be thrown away in an attempt to alter us. A child or an idiot, perhaps, may be wheedled into wondering applause of any display of grandeur wherever it is found, but a man of sense, although little conversant with a number of edifices, will feel disgust at such misplacement and confusion of ideas.

Thirdly, A villa is destined for the accommodation of a family in a state of comfort allied to elegance. It is not a nunnery, nor a prison, nor a military fortress, nor a menagerie, nor a church. Why then does it claim kindred to them by very striking resemblance? Fashion will have it so. A house cannot be built every day to correspond with its capricious dictates. But the relations of utility, of fitness, expressiveness of design and object, exist for ages. The utmost influence that fashion ought to claim is that of regard to the character of the times in which we live. The days of monastic seclusion, gloomy superstition, and feudal despotism, are gone by,—we are not now to be bewitched with glass angels and marble saints, or horrified with ghost-trodden turrets and enchanted halls.

Lastly, The correspondence of all the parts of the villa with each other, and the general design, indicate chastity of thought and simplicity of plan. This, when the expression itself is agreeable, is an excellence of high value. Not that we enjoin perfect regularity or an undeviating uniformity in the structure of a villa. Formality is here a vice; so that the plan which renders it necessary in order to fine effect, seems to have been intended for a street and not the obliquities and irregularities of nature. But we contend, on the other hand, for a discoverable subjection of every portion of what we know to be artificial to the arrangement and intelligence of mind; and we cannot even behold that mind, either frivolous or given to freaks, without a painful suspicion of insanity. Houses, we know, are costly things, and building occupies many years and much thought; it is miserable to reflect, that the product is often whimsical and trifling. A mixture of different orders, then, we think, implies an erroneous judgment, to say nothing at all about the transgression of rules; and a tenacious adherence to a set form, excites a notion of a narrow taste and a poor imagination.

On the whole, we dislike imitation, whether of the Grecian, Roman, Oriental, castellated, or Gothic architecture; and there is no difficulty in obtaining a suitable individuality of character. A man of genius in his profession will never be a slave; he will study, indeed, the works of others, and avail himself of their experience, profiting as well by their defects as their excellencies; but with an eye and a heart inspired by truth and nature, like the genuine painter or the poet, he will identify his conceptions with the characters of his subject, and embody them in materials destined, like his fame, for immortality.

For views and examples of what has been done, and may be done, we refer to "Plans and Views of Buildings executed in England and Scotland," by R. Lugar, Lond. 1811; "Designs for Villas, &c." by Edmund Aikin, Lond. 1808; "Designs for Elegant Cottages and Small Villas, &c.," by E. Gyfford. Lond. 1806; "Sloane's Plans, &c. of Buildings executed in the counties of Norfolk," &c. &c.

The general reader, who wishes merely for information in the way of amusement, without having any specific object in view, may have recourse to almost any of the works published under the titles of Tours, Excursions, Trips, Road-books, and Directories, &c. &c.

Sect. IV. *Of Grouped Houses.*

By this denomination we mean those assemblages of buildings which constitute the streets, squares, crescents, &c. of villages, towns, and cities. The difference between them and the solitary structures hitherto treated of is both considerable and important. A new character is acquired, or at least a certain sacrifice of freedom is called for, something like that which a savage must make on becoming a member of a civilized community. He submits to restrictions, certainly not very natural, but ultimately instrumental to his welfare, and at all events essential to the public peace. The villa stood peerless in the field, owning only the superiority of the neighbouring hill and the canopy of heaven; even the cottage had an air of independence which it shared with the friendly thicket, or which enabled it to afford protection to the jessamine, the rose, or woodbine that grew around it. But in the town, redundancies must be lopped off, irregularities confined, order and method studied, every thing must be regimented, schooled, and trained by the precepts of law and the compliances of courtesy. Individual taste and inclination yield to the demands of general convenience. Certain private decorations, or supposed elegancies, notwithstanding, are usually allowed, and ought, indeed, as much as possible to be so, because the prevalent vice of a town in respect of taste is monotony, which is seldom enough broken or counteracted either by this indulgence or the occasional appearance of large and special edifices. There is a very striking difference, in this particular, between ancient towns and those erected since the establishment of regular police and good government. The former seem to have been the product of accidental meetings of cottages, and villas, and castles, and have the interest, therefore, of variety and chance; the latter, on the contrary, are evidently the result of preconceived combinations and adjusted designs, indicative of well-directed intelligence, no doubt, and possessing superior advantages, but at the same time wearisome as the method of a Dutch garden, and totally opposed to every romantic idea. A single city will sometimes afford a complete illustration of this remark, and the case of the Old and the New Town of Edinburgh, to go no farther, is quite in point. An observer, standing on the south-west side of the Calton Hill, which commands both, is instantaneously impressed with a conviction of the happy order and useful arrangement of the modern streets; but a dissatisfied feeling follows, the natural effect of so much stiffness and formality. All the portions of which they are constituted are so extremely alike, that not one has had ambition or pride enough to surpass its republican fellows. In short, the whole is utterly destitute of the expression of grandeur and bold enterprise. On the other hand, the Old Town is at first sight positively offensive by its appearance of confusion and inextricable disorder. But the mind is soon hurried off from this impression, to contemplate, with a kind of poetic ardour and delight, those endless projections, heights, and precipices, by which the hand of man seems to have rivalled the sublime works of nature in their neighbourhood. No where else, we believe, shall we find such confronting extremes. We regret, we must add, that the contrast has been pushed so far, and that a subject, of almost unexampled capabilities, has been so tamely treated. But some relief may be effected by the judicious outlay of the intermediate space; an object of no less consequence than the stupendous embellishment now executing.

Every town ought to contain all those conveniencies which a large society requires; its wells, markets, and places of resort for universal concerns, &c. &c. Health and cleanliness, so difficultly preserved among great masses of mankind, ought to be an object of legislative interference, much more, we have no hesitation in saying, than the opinions and creeds of the people. For these purposes, certain situations are to be preferred, as favoured by climate, soil, exposure, and accidental advantages. For the same reason, the streets ought to be wide; nuisances must be provided for by proper covered drains, and every facility and encouragement given to study neatness and elegance of aspect: A wise and benevolent government would even go farther; and by the politic establishment of promenades, and places of exercise and amusement, either free of entrance, or accessible by moderate means, would cultivate the salutary recreation of both mind and body. No one can witness the squalid, dejected countenances of the lower order of people in large towns, especially in manufacturing towns, without being convinced that there is a lamentable neglect of their highest temporal interests. A century hence, we venture to foretel, unless some extraordinary change take place, the population of Britain, tending, as it does, with portentous rapidity, to eke out the misery of large towns for the greater convenience of trade, will be unable to raise a body of warriors fit to emulate the hardihood and deeds of their forefathers. The observations of Sir James Macgregor on the Medical History of the Peninsular War, fully warrant such an opinion.

Long streets are to be frequently broken for the greater facility of intercourse. Diagonal crosses are more expeditious than right angled. Squares and crescents not only give elegance, but also promote free exposure. Very high houses are troublesome, and preclude sufficient attention to cleanliness. Streets ought to be well furnished with flagged footpaths, having an inclination outwards to the gutter, to permit rain to flow off expeditiously. The particular style of building for the private houses we hold to be a matter of complete indifference, provided they be well supplied with windows of a large size, have a lively appearance, and admit of tasteful decorations.

Sect. V. *Of Public Buildings.*

Public edifices, in a great degree, determine the character and condition of nations. The general concerns of communities require larger places of resort than what are used as dwellings by private persons. Religion, education, amusement, political establishments, and many other institutions, such as no civilized country is altogether destitute of, are of universal interest, and bring large masses of mankind together. Even those constitutions which are most opposed to the liberty of the people, permit and in fact enjoin occasional assemblies as conducive to the ends of government. In the nature, number, and appearance of the edifices, where they occur, we may generally discover a good deal of their history, and of their most striking moral and political features. The style of architecture adopted in them, whether original or derivative, testifies something of their former state and the advancement they have made in the arts of civilization; whilst their present features have invariably an influence on their efforts in this art, and not unusually impress very peculiar marks on its more considerable productions. It is certainly the study of nations, no less than of indiduals, more especially those which encourage intercourse with other people, to procure and maintain respect by the display of what are esteemed symptoms of prosperity. As an indication, at least in the case of states not tributary, this display may more frequently exceed the reality than be below it. But the pride, or good policy in the one case, and the affected humility or sincere parsimony in the other, are equally traits of character to which a well informed observer will give due attention in forming his estimate. The writers on political economy have not been sufficiently studious of this department of statistics.

But though the objects of public buildings, and the means for erecting them, be national, or concern communities of mankind; and though generally there is a certain style of architecture more prevalent in a country than another; yet, on the whole, it is the taste of a few individuals that modifies the existing art. There is indeed a re-action between the conduct of these individuals and some pretty well established prejudices, so that they rarely can accomplish their entire inclination, and thus the public are tolerably well secured against any considerable revolutions. Changes of style, in fact, are neither frequent nor speedy. We have evidences of this in the similarity of many edifices which have

Of Style.

been erected at very distant periods of time. Associations, it would appear, are formed in the minds of most people, which it is unsafe, if not impracticable, to dissolve. Nothing, indeed, can justify the attempt but reasons of expediency so obviously or so easily discovered, and of such a degree of urgency as cannot fail to carry conviction to ordinary minds. Capricious innovations are surely as much to be condemned as the obstinacy that resists their establishment; and if all other circumstances be alike, a preference is due to those models which have been sanctioned by public esteem. At all events, a difference in the circumstances ought to be as considerable as the amount of deviation that is hazarded. Neglect of this precaution occasions much of the dissatisfaction which is expressed against certain kinds of edifices. Generally speaking, there is prudence in conformity, although originality be essential to excellence. But there are a thousand stations between a complete copy and extravagant singularity which ordinary artists may commendably fill up with their productions.

Few errors, perhaps, would be committed, and undoubtedly few important alterations in style would be projected, were a metaphysical conceit got rid of which we have already endeavoured to expose, viz. that some forms and proportions are naturally more beautiful than others. Were they to abandon this mischievous absurdity, artists would almost certainly avoid the evils of affectation, and at the same time secure for their works the beneficial operation of those principles of judgment on which the decisions of taste are founded. It is of consequence for them also to remember, that no combination of the materials on which they work can ever express any of those pasions of the mind that are the objects of sympathy, and the source of the interest we take in the history and actions of our fellow creatures. In this respect, architecture is inferior to painting and sculpture, confined as they are to indicate the signs only of these passions, and to delineate the momentarily co-existent assemblage of events to which they give rise. But, perhaps, within its range of expression, it equals those arts in the amount though not the quality of effect on the feelings. That mind certainly is extremely dull, if not defective in a faculty, as many are with respect to musical ear, which is not susceptible of peculiarly strong emotions on the contemplation of its nobler monuments, independent altogether of regard to the ultimate ends for which they were intended.

The emotions thus produced are not always the same, but differ in different cases, according to the associating principles brought into action; and hence they furnish us with some means for pointing out the nature of buildings, and at the same time of heightening the effect which the consideration of that nature, when pointed out, is calculated to produce. These principles, then, being once established, become as powerful on the mind as if the forms, proportions, and appearances with which they are connected, or which tend to excite them, were naturally and essentially expressive, as has generally been imagined. It is this apparent concurrence with a matter of fact, accordingly, that has given the theoretical opinion now alluded to its most specious claims. But there are not wanting other instances of the partial accommodation of an erroneous hypothesis to the phenomena of nature. Is there one, indeed, among the thousand false notions which domineer over the mass of mankind, that could maintain its place in their esteem without some such recommendation? But it is not enough to entitle a theory to the honours of a law of nature, that it affords a satisfactory explanation of many facts; the principles on which it is built must be shewn to have an actual existence. In the present case, there arises a decisive objection, from the circumstance of a more general principle than what is assumed by this theory, one, too, of whose reality we have the highest convictions of experience, requiring no such aid to account for all the facts in question.

It is the business of the artist, then, to ascertain the peculiar associations which take place in various cases. He must have recourse to experience, distrusting altogether the pretensions of rival systems; and the results of his own unbiassed examination ought to be as imperative on his practice, as any deductions from a theory which might even possess the authority of a law of nature. The more extensive his observation has been, and the more scrupulous his caution to discriminate between associations that are of universal occurrence, and those which are the product of accidental and rare combinations, the greater is the probability that he will avoid narrow prejudices, and accomplish the higher destinies of his art. If the advantage of travelling be denied him, and of course the benefit of personal inspection, he must endeavour to remedy the deficiency by the liberal study of the best descriptions of public edifices in different countries and styles, taking care to form his taste on the general conceptions which arise in his mind rather than the more intimate acquaintance he may possess with particular examples of excellence. What but some paltry notions allowed to spring up in the mind during the neglect of this corrective discipline, and that inveterate propensity in unpractised reasoners to draw general conclusions from particular premises, could give rise to the empirical dogmatism and ostentatious trumpery practised in this profession? It is lamentable, that the very censure which is occasionally bestowed on the more absurd of these vices, commonly proceeds on a principle which recognises the sacredness of the parent delusion. The taste of the artist, indeed, is condemned; but this being supposed entirely a *voluntary* principle, his deficiencies of information and judgment escape detection, though, in reality, the *necessary* source of his errors. Taste, properly speaking, is little concerned in the matter. The artists too often employed are mere jobbers, who have not had time, inclination, or talent to cultivate what is deserving the name of that faculty; and those who employ them are often too ignorant to suspect that what is offered to their admiration is an absurdity. The evil, which is abundantly important to excite solicitude, requires a double remedy. In the first place, the public mind must be rectified as to the objects and capabilities of architecture; and, 2dly, men intended for the profession ought to undergo a

Of Style.

regular and scientific education. Is it not desirable for both purposes, but peculiarly for the latter, that our universities had endowments for teachers of this most useful art, and that attendance on their instructions for a certain time, and an acquaintance with several subsidiary branches of knowledge, were enjoined on all those who aspired to the honours and emoluments of its practice?

In considering the characters of public buildings, three questions present themselves. 1. Is it possible, or necessary, to suggest the nature or object of such buildings by visible signs? 2. Does the art of architecture afford such signs? 3. What are the species or kinds of architecture peculiarly suitable to the intended manifestations? These three questions might all be resolved into one, viz. What are the emotions actually excited in the mind by the productions of this art? But it will be found most advantageous for the student to investigate the topics separately.

The first question involves two particulars, the practicability and the expediency of intimating design. As to the former, we may remark, that from the earliest ages it has been imagined not only possible but even easy, to express affections of mind by the forms and qualities of matter. The arts of the statuary and painter, considered as distinct from the mere imitation of things, proceed upon this supposition; and accordingly we find, that the ancient professors of both arts often busied themselves in figurative or emblematical representations of ideal objects. In course of time these figures became as generally significant and well known as the correct delineations of individual persons. There are familiar examples in the emblems of justice, plenty, faith, hope, &c. &c. handed down to us, with little alteration, from very early times. But these instances are far from deciding the present question, though they seem to indicate the universality of the opinion, that abstract qualities may be signified by visible forms. It is evident, that, even admitting the correctness of such forms considered as signs, it still remains to be determined whether or not the intention, or object, of buildings bear a resemblance to the qualities thus indicated. Here it would be requisite to enquire, therefore, into the variety of ends contemplated, or, in other words, to specify the kinds of edifices. A list of these would present many diversities, allotted to the distinct purposes of civilized societies. Then the question would be, how far do any or all of these correspond with such mental qualities as have been alluded to? Perhaps the utmost licence which could result from the inquiry is, that each of these diversities having a close affinity with one or other of the ideal beings, may, therefore, be designated by its respective emblem. Thus, for example, the mere intention, motive, or object, which prompted to the erection of a church, hospital, or court of law, might be represented by figures significant of piety, health, or justice. But, in all this process, it is evident, we have not got beyond the arts of sculpture and engraving; and hitherto not a hint is suggested which could be of the slightest utility to the architect. Though it appears, therefore, impracticable to suggest the nature of a building by any sign expressive of the intention which led to it, yet there is every reason to believe that when that nature is by any means discovered, then there may immediately arise a conviction of its suitableness. Accordingly, the appearances which excite this conviction are not unfrequently conceived to be expressive of nature itself; and, in reality, it will be found that the expediency, or necessity, of signifying this nature, is resolvable into the propriety, or advantage, of exciting such a conviction. This is the origin of the doctrine of fitness, as it is called, to which some incautious reasoners have referred the pleasurable emotions arising from some of the productions of the art. There is still another source of error, to which it is necessary to advert before proceeding to discuss the second question. It is the confounding together the end or object of a building and the emotion which that end is fitted to excite. For the former, it now appears there is no significant expression in the art; in other words, the productions of the art do not directly suggest the purposes for which they are intended. But the latter, it is certain, may be, and often is excited, naturally or conventionally, by the building itself. This is an important distinction, and at once conducts us to the legitimate aims of the art, by pointing out the peculiar expression of which it is capable.

We are now furnished with a qualified answer to the second question. Architecture does not supply signs from which we can directly infer the ends, or purposes, of its productions, but it is capable of exciting some, at least, of the many emotions which these purposes or ends, when accomplished, occasion in the mind. Hence, then, from the emotions we may judge of the purposes. It now becomes an interesting inquiry, what are the emotions which it excites? And from this again necessarily results the determination of practice in every case of consequence. The emotions are numerous, as may easily be ascertained by experiment, or by perusing almost any of the works which treat of architecture as a fine art. We have given our reasons already for preferring the enumeration and arrangement which Mr Alison has adopted, without being perfectly satisfied that he has quite exhausted the subject, or taken into account every circumstance which is likely to influence it. The attention of the artist is peculiarly demanded here, because in no exercise of his profession is he so liable to gross error as in fixing on the kinds and degrees of emotion which are to be excited. He must know the precise capabilities of the art, in the first place; beyond these he cannot take a step without certainty of failure. The kind, again, is pointed out by the object or purpose in view; and the degree is limited by the fund on which he operates, and the peculiar circumstances of the case. Lastly, he must be cautious not to attempt the production of contrary, or too many emotions. Perhaps every instance of considerable error may be referred to a neglect of one of these simple rules; and, on the contrary, a certain degree of success must be the infallible result of attending to them.

The last question which has been stated, can only be solved properly by the results of experience.

Of some of these it is necessary to speak. The effects of architecture are of two kinds, those which immediately spring up in the mind on the contemplation of the objects, and those which take place through the medium of the principle denominated the association of ideas. One building may produce both in the same individual; and, in general, the effects which do occur, are determined as much by the peculiarities of the spectator's character, as by the nature of the building presented to his notice. Hence the difference between the judgments pronounced by the vulgar and the man of cultivated taste, both equally sincere expressions, it may be, of the real effects which are experienced. It is clear then, that, in determining this question, we must condescend on the individuals, or characters of the persons who are to decide, else the answers would be various, and in reality contradictory. How absurd, therefore, is dogmatism in this case, and how endless the controversies which are frequently agitated on the merits of different kinds of buildings! But let us not carry this observation too far. It must be restricted to the second sort of effects, for as to the first, it may be easily made to appear that there can be little or no disagreement of feeling.

Every distinct quality, we apprehend, is productive instantaneously of a distinct emotion in all the individuals who observe it. But it is not obviously true, that every emotion admits of being distinctly stated in language. The fact is, that few persons so far discriminate between their emotions, as to be able to present them in any creditable form to their understandings. Some general terms are usually employed to denote the larger differences of classes of emotions, and hence we speak of agreeable and disagreeable, certainly the most universal of such terms,—or of gay and melancholy, lively, dull, &c. &c. But the minuter shades of difference escape detection, perhaps because of the merely momentary existence they have in the mind, or from a habit of inconsidertion as to what passes there, of which every person must be sensible, when not roused by some powerful motive. Now, were there no other principle to operate, buildings of very different characters might produce emotions so much resembling each other as scarcely to admit of distinction, at least in common language. This is actually the case with the generality of people, who will be found to express themselves alike respecting very dissimilar examples. It is evident, then, that their praise would afford little satisfaction to an artist; and hence he is induced to seek the approbation of persons who, besides their agreement in the common emotions, are likely, by their education and studies, or the natural susceptibility of their minds, to experience the secondary but higher effects which his art can produce. This is certainly an appeal from the many to the few, and having been often practised has at last constituted a tribunal of taste, whose decisions are almost irreversible, and before which every intelligent artist is anxious to bring his productions. It is fortunate for the credit of this tribunal, that all its decrees *may* be perfectly, and now perhaps generally are, reconcileable with the sentiments and conclusions of the unlearned. There is every reason, therefore, for preferring its reply to the question before us; and hence, it is absolutely incumbent on the student to familiarize his mind to all the varieties and degrees of emotions, primary and secondary, occasioned by the different styles. The former he may easily ascertain by attending to his own sensations; the latter must be learnt from frequent and careful comparison of the criticisms and observations on the most remarkable specimens of the art, which abound in many well-known publications.

History of Architecture.

Origin.—It is vain to seek for the origin of this art among any particular people, the necessity for it, and the genius required in its cultivation, being as universal and as various as the materials on which it operates. It has been practised, we know, in every country, and in all ages, favoured with the benefits of civilization. The savage life itself is rarely destitute of some artificial defence against the violence of the elements and the ferocity of wild beasts; and those contentions in which rival tribes so frequently engage, have furnished powerful motives towards its invention and exercise.

We have an illustration of this last remark in the Hippahs or Heppahs of New Zealand, described by Captain Cook. The incessant hostilities of the natives of that country have converted their villages into forts. Speaking of one of them, that navigator says, "the best engineer in Europe could not have chosen a situation better adapted to enable a small number to defend themselves against a greater;" and, considering the imperfection of their tools, the structures themselves, according to his description, must be allowed to display great judgment and ingenuity. In the accounts of the voyages performed by this very intelligent officer, we are occasionally supplied with curious information respecting various degrees and kinds of primitive architecture. Even the miserable huts of Easter island, one of the most forlorn and unfortunate of the islands he visited, manifest skill, though vastly inferior to that of the Otaheitans and other people. They are "constructed by setting sticks upright in the ground, at six or eight feet distance, then bending them towards each other, and tying them together at the top, forming thereby a kind of Gothic arch. The longest sticks are placed in the middle, and shorter ones each way, and a less distance asunder, by which means the building is highest and broadest in the middle, and lower and narrower towards each end. To these are tied others horizontally, and the whole is thatched over with leaves of sugar-cane. The door-way is in the middle of one side, formed like a porch, and so low and narrow, as just to admit a man to enter upon all fours." The largest house seen here by Captain Cook was about 60 feet long, eight or nine feet high in the middle, and three or four at each end; its breadth at these parts being nearly equal to its height. It is very singular, that this island, so remarkable for some gigantic figures of stone, contained also certain buildings of the same material. We are indebted to Mr George Forster, who accompanied Cook in his second voyage, for some particulars respecting them, History. which the reader will find in Kerr's Collection of Voyages, &c. vol. 14. p. 272. It is in such conditions of mankind as have been discovered by modern travellers and navigators, that we are provided with an unanswerable objection to those claims for the supposed honour of giving rise to this art which have been advanced by fanciful writers in behalf of different nations. Architecture, they seem to prove, is the creature of circumstances that are by no means confined to any period or region of the world.

The instances of contrivance and skill now alluded to, render probable the historical relations that have come down to our times, respecting the prevalence and extent of this art among the earlier generations of mankind. Admitting that these possessed an equal share of intelligence with modern savages, it is surely fair to imagine that they were at least equally successful in cultivating so important an art. But there are not wanting reasons for the opinion, that the exertions of some of them could scarcely fail to be much more considerable. At all events, the essential advantage of that long space of time which they continued, must have occasioned a decided superiority on the part of those people who had earliest arrived at civilization. This probably has originated and strengthened the notion, that some particular nation invented the art, though completely at variance with every distinct example of underived national style. Priority of invention and employment may be conceded to the Egyptians and some of the eastern people, without robbing others of the merit of originality.

Early condition.—We are chiefly concerned with the state of architecture in Egypt, the country from which the Greeks, to whom the western world is indebted for its first acquaintance with the fine arts, derived their instructions. This, then, may be considered, without any determination of a question which has often agitated antiquaries,—viz. whether Egypt or one of the eastern countries was the parent of the art. It is sufficient for us to observe with respect to this discussion, that Egypt, Phœnicia, Chaldæa, India, and China, may be proved, on respectable authorities, to have made considerable advancement in architecture in very early times; but that it is extremely difficult, if not impossible, to ascertain which of them was soonest engaged in it.

The immediate descendents of Noah, it is probable, retained some of the knowledge of the Antediluvian generations, which might serve as the basis of the art practised by them as long as they continued united together, and for some time after their separation at the plain of Shinar. We learn from the Mosaic account, certainly the most authentic history of this period of the world, that several cities had been built prior to the undertaking at Babel, which occasioned that event. Their names are given in Genesis, x. 10. &c.; but no information is afforded respecting their extent, or the materials of which they were formed. Stone, we may almost positively declare not to have been used. The cities of the plain, we may add, whose lamentable overthrow could not be averted by the intercession of Abraham, consisted of combustible materials, which we know were generally used in the architecture of ancient times. History.

Egypt, it appears, however, never abounded in wood; and accordingly its inhabitants had recourse to bricks formed of a kind of mud or clay, held together by means of straw, and hardened by exposure to the sun and air. There is ground to believe also, that they very early employed stone for the same purpose; and the art of dressing it has, with some propriety, been ascribed to them. Their ingenuity and science were soon distinguished among the neighbouring nations; and it is mentioned to the credit of the Jewish lawgiver, in after times, (Acts vii. 22.,) that he "was learned in all their wisdom." President Goguet, who has treated the subject we are now upon with his usual discrimination and industry, is of opinion, that some of the embellishments of the tabernacle erected by Moses in the wilderness had been previously adopted by them. "I believe really," says this sensible writer, "that there must have been some relation between the Egyptian temples and the tabernacle. It is true, strictly speaking, this work ought not to be looked upon as a piece of architecture; it was only, to speak properly, a vast tent; this is the first idea it offers to the mind; but, by reflecting on it more attentively, we shall perceive that the tabernacle had a great relation with architecture. We ought to look upon it as a representation of the temples and palaces of the east. The whole construction presented the model of an edifice, regular, and distributed with much skill." Its columns, surmounted with chapiters, give us an idea of the essential part of an architectural order. Viewed in this light, as a monument of the existing taste, we cannot help thinking that architecture had already got far beyond the state in which it merely yielded shelter from the weather, and had assumed an important rank as a fine art.

Among the Egyptians.—To the reign of Sesostris is ascribed the principal part of those buildings, whether intended for utility only or embellishment, which rendered Egypt so conspicuous in the list of kingdoms. But it is impossible exactly to ascertain the time in which this remarkable personage existed, and many of the relations concerning him appear unworthy of credit.

Thebes, the capital of Egypt, is immortalized in the poems of Homer, as the richest and most populous city in the world, so early as the time of the Trojan war. If there were not reasons for believing that the bard judged of it by comparison with the still inconsiderable cities of Asia Minor and Greece, and indulged his fancy in the description he gives of it, we might be induced to assign it the highest place among the wonders of ancient art. The concurrent voice of other authors seems to demand this as a right; but there is always room to suspect the existence of a disposition towards the marvellous in their representations, and that they were more anxious to improve on previous reports, than careful to ascertain their accuracy. No greater evidence of this remark, perhaps, will be asked for than the assertion of Pomponius Mela, that this city contained within its walls a million of warriors; whereas Herodotus reckons only forty-one thousand in all Egypt! But allowing for exaggerations, sufficient truth remains to call forth admiration. The ruins of this famous city, which have frequently been visited by modern travellers, testify an extent and magnificence to which there are not many parallels in past or present times. But it ought not to be forgotten, that these ruins are the mingled product of the original city and the subsequent productions of Grecian and Roman power, which successively triumphed in this celebrated region. A very minute and skilful examination would be requisite to determine the respective shares of each; and this adjustment is the more difficult, because it is probable that both the latter partook a good deal of the Egyptian taste and manner. Those who wish to be informed as to what has been done in this way, will find enough to gratify their curiosity in the travels of Pococke, Norden, and Denon, not to mention others spoken of in Goguet's work. The account which Mr Hamilton has given of the ancient and modern state of Egypt, may also be profitably consulted.

Thebes deserves to be called the city of temples, so many remains of these buildings being discoverable in its ruins, and some of them indicating, by their size and appearance, the immense consequence that had been attached to religion. The reflections of Denon on this circumstance are worthy of notice, and are well borne out by the observations of other writers: "Still temples, nothing but temples! and not a vestige of the hundred gates so celebrated in history, (especially by Homer); no walls, quays, bridges, baths, or theatres; not a single edifice of public utility or convenience; notwithstanding all the pains which I took in the research, I could find nothing but temples, walls covered with obscure emblems and hieroglyphics, which attested the ascendency of the priesthood, who still seemed to reign over these mighty ruins, and whose empire constantly haunted my imagination."

Of Memphis, the second capital of Egypt, built several centuries after Thebes, not a vestige remains to mark the spot where it stood. But in the vicinity of the place assigned to it, not far from Cairo, on the opposite side of the Nile, are found those stupendous structures the pyramids. It is worthy of notice that Homer never makes mention of these singular edifices, nor of the name of Memphis. This is most probably accounted for on the supposition, that neither the one nor the other existed in his time. The descriptions of the pyramids of Egypt, of the famous labyrinth near the lake Mœris, and of various other remarkable structures, belong to another department. There were many more cities in this region, of which mention is made in different classical authors, but it is unnecessary to specify them in this place. Alexandria, founded by the Macedonian conqueror, and in great measure made up from the ruins of Thebes, cannot be considered as belonging to this period, or in any degree illustrating the history of Egyptian architecture, as it was built by a Grecian, and in the Greek taste.

From all that can be collected in ancient authors, and in the reports of those travellers who have visited this country, it will not be difficult to form an opinion of the state of this art as practised by the Egyptians. Their notion of perfection in buildings corresponded exactly with that of a certain people we have somewhere read of, as to beauty in women. Bulk is the main thing aimed at. In endeavouring to accomplish this, the nature of their materials, and their ignorance of scientific principles, forced them to adopt the simplest and least hazardous forms. Immensity of dimension required enormous strength, and occasioned a durability to which perhaps nothing but wilful aggression could set limits. Cambyses signalized his mad invasion of Egypt by this ungenerous device. Subsequent conquerors followed his example. But enough remains to point out its nature and principal features. These may produce an emotion of awe somewhat allied to sublimity, but are altogether destructive of pleasurable ideas. In the Egyptian edifices, in short, all is cumbrous, inelegant, and clumsy; and the very ornaments are calculated to disgust a mind that had ever been gratified with the insinuating graces of a purer model.

The Egyptians, it is demonstrable from their works, knew nothing of the nature of an arch, and appear not to have used timber in their larger edifices. These circumstances account for much of what is objectionable in their building, particularly the constant adoption of flat roofs, often of great size, and consisting perhaps of no more than one piece of stone, and the multiplication of huge columns, necessary indeed for support, but productive of an embarrassed and heavy appearance. The hasty assertion of M. Dutens, in a work published several years ago, (*Recherches sur le Tems le plus reculé de l'Usage des Voutes ches les Anciens,*) in which he has attempted to carry back the discovery of the arch to a very early period, viz. that there are examples of it to be met with in the remains of Egyptian architecture, is easily explained by a circumstance which he appears to have neglected to consider. We mean the introduction of both Grecian and Roman science into that country long after the times in which its inhabitants could boast of independence. There is an excellent *critique* on this work in the Edinburgh Review for January 1806, where the fanciful opinions of the author, and his gross errors, are exposed beyond the possibility of defence. In so far as Egypt is concerned, Goguet had successfully anticipated and replied to the question. See the translation of his admirable work on the Origin of Laws, &c. printed at Edinburgh, 1761, vol. 3.

In the east.—Before proceeding to notice the state of architecture in Greece, it will be proper to make a few observations on some of the cities of the east.

That part of Asia which is denominated, from the peculiarity of its situation, Mesopotamia, has been pretty generally fixed on as the original seat of civilization, and, indeed, of mankind. However this be, certain it is that some of the most ancient and largest cities in the world were built in or near it. Of these, Nineveh on the Tigris, and Babylon on the Euphrates, have attracted the greatest attention. We have ample accounts of both from sacred and profane writers. These will be elsewhere considered; we have merely to mention at present the probability of their resembling each other in size and appearance, and that there are now no traces of their existence to be met with, from which we could form the faintest conception of their style and magnificence. The vestiges in the site of the latter remaining in the fourth century cannot be supposed more ancient than the attempts, very feeble ones it must be allowed, made by Alexander, and some of his successors, to restore its former glory. After the ruin of the Assyrian empire, the Persian monarchs generally resided in Susan, Ecbatana, and Persepolis. The ruins of the palace in the last named city, imagined to be the same that was destroyed by Alexander, have been particularly described by Le Brun, and are occasionally noticed by later travellers. Seleucia, (the modern Bagdad,) Heliopolis, or Balbec, Palmyra, or Thadmor, &c. &c. are to be ascribed to the Greeks and Romans, and do not, therefore, properly speaking, belong to this part of our subject. It is unnecessary for the object we have in view to make mention of the cities of India, China, &c. We turn, therefore, to the history of architecture, as descending to the western world, through the purifying channel of Greece.

Among the Greeks.—The progress of the Greeks from obscurity to the highest fame, is one of the most inviting events in the history of mankind. Their poor beginnings in a small territory, always liable to be overwhelmed by their neighbours, could afford no promise of the dignity to which they afterwards attained. It is not easy to assign very satisfactory reasons for the rapidity of their rise. Political circumstances, perpetual jealousies the almost infallible attendants on minute divisions of the same region, and perhaps, in some degree, the physical peculiarities of their country, all come in for a share in the effect; nor ought we to forget the advantages which they derived from occasional intercourse with people more advanced in civilization. The greatest men in ancient Greece accomplished themselves in useful learning during their travels and residence in foreign countries. Architecture is one of the arts for which, beyond the erection of the merest hovels, they seem to have been indebted to Egypt and Asia. But it was their ingenuity and good taste which elevated it to the rank it now holds, and which still predominate in it wherever it has been liberally cultivated.

We shall pass slightly over the state of architecture in the earlier ages of their history, as too obscurely mentioned by the ancients to yield satisfaction, and too insignificant to warrant much inquiry. Their first buildings were composed of wood, with which some parts of Greece abounded. The piety of the people gave rise to temples, though for long of very mean structure and appearance. The temple of Delphos, for example, afterwards so famous, was originally no more than a thatched building, covered with laurel branches.

Cadmus is supposed to have introduced the use of stone into Greece, as a substitute for wood. The cities of Argos and Eleusis are understood to have been founded by the first sovereigns of this country. Throughout the whole of what have been called the heroic ages, architecture was imperfectly practised, and had not risen to any dignity as a fine art. Great attention was paid, indeed, to the decoration of the inside of houses, but the rules for proportion and the principles of style were not then understood. None of the edifices described by Homer, for instance, give us any idea of ornamental building, nor does this poet seem to have had the slightest conception of an order. He mentions but does not describe the temples of Minerva and Neptune; and his language, in speaking of the columns of certain palaces, implies that they were merely posts of wood. We may confidently affirm, that no very great improvement took place in this art till a considerable time after the Trojan war. The colonies established in Asia Minor, subsequent to that event, are, with much probability, credited with the chief discoveries and embellishments. The former inhabitants of that region had been careful enough to decorate some of their edifices. This may be presumed from Homer's account of the palaces of Priam and Paris, in which he speaks of porticoes and polished stone, but in so vague a manner that it is impossible accurately to find out his meaning. (See Cowper's Homer's Iliad vi. line 277, &c. and Goguet's Remarks on the expressions used by the poet.) The arts of preparing stone for building and sculpture, if not painting and working in metals, were probably derived from the Phœnicians, the most enterprising people in that age of the world. Mechanical knowledge, however, was still very imperfect and confined among the Greeks, from which we may infer the improbability of their having erected any considerable buildings in this early period.

Orders invented.—The Doric and Ionic orders were invented by the Asiatic Greeks, but at what period is not exactly ascertained. Vitruvius, an author much valued for his information on the subject of this art, has placed it too early; for it is inconceivable that Homer and Herodotus, and other writers, should have passed them over unnoticed, if they had been in existence before their time. These orders were no sooner discovered than they were universally adopted. Almost every province in Greece testified its approbation of the first models, and temples and other edifices in imitation of them multiplied with great rapidity. This people, in general, shewed extreme modesty in their private dwellings, reserving the excellencies of their architecture for public purposes. An individual, whatever his riches or power might be, would perhaps have incurred some danger in an attempt to surpass the common neatness and simplicity of his countrymen. Modesty of appearance, indeed, is a virtue which the members of a republic find it a wise policy to cultivate. The influence of this spirit might even be exerted on the style of the public edifices themselves, which certainly secured powerful effect without the aid of minute decorations.

It is questionable if the Corinthian order, which was not invented till some time after the others, were not too gaudy for the sublime conceptions and simple taste of this people during the best part of their history. Certainly it is seldom to be met with in the remains of their edifices erected before the predominance of the Roman power. The fatal consequences of the Macedonian conquest on the independence and politics of Greece, had previously been extended also to their efforts in this art. Their finest and most dignified productions were the offspring of a better spirit than that event could engender. It was late in the progress of this art that the Greeks employed the different orders together in the same building. The chief edifices of antiquity were all in one order. Of the Doric, may be mentioned the temples of Juno at Argos; Jupiter Nemeus between that city and Corinth; Jupiter Olympius at Olympia; Juno and Minerva at Elis; Minerva, (the Parthenon,) at Athens: Juno in the isle of Samos; and Apollo in Delos. The Parthenon built in the time of Pericles, the great promoter of the arts, is esteemed the noblest example. The temples of Diana at Ephesus and Magnesia, those of Æsculapius and Apollo at Athens, of Juno in Attica, and many more, were of the Ionic order. The fine examples of the Corinthian were reserved to signalize the conquests and luxury of the Romans. For particulars respecting the construction of the Greek dwellings and the remains of the nobler edifices, &c., we refer the reader to the Abbe Barthelemi's Travels of Anacharsis; Stuart's Antiquities of Athens; and the work of Vitruvius. The critique in the Edinburgh Review as to the use of the arch among the ancients, formerly alluded to, merits a careful perusal. We entirely agree with the writer, that no unequivocal example of it, as a principle of construction, is to be found in Greece or any of the neighbouring states before the age of Alexander the Great, about which time, and no doubt greatly in consequence of the immense revolutions that had taken place in their political affairs, most important changes in their arts and sciences and taste were effected. But, on the other hand, there is every reason for concluding, that the pointed roof was much earlier employed in their temples and other large edifices, if not for the opinion that it was actually the invention of this ingenious people. M. Dutens, probably, has confounded together this form, or some mere modification of it, with that scientific arrangement of materials on the principle of equilibrium, to which alone the name of arch is properly applied. The roofs constructed by the Egyptians, the Persians, and most other eastern nations, were always flat. How the arch might have been discovered we have elsewhere shewn.

The Romans copy the Greeks.—It is a consolatory thought to a benevolent mind, that the empire of genius is more permanent than that of military power. Unlike the latter, it is not merely tolerated from a conviction of necessity, which every feeling of the heart is disposed to terminate, and which soon or late must vanish before the accumulated energies of human will, but is rooted in the affections and faculties of mankind, and acquires strength from the infant curiosity and awakening zeal of every new generation. Those tyrannies of the ancient world, which so long rioted on liberty and curbed the feeblest effort towards improvement, as hostile to their continuance, could not altogether destroy the natural inclination for change from which that effort proceeded, nor prevent the disclosures of time and casual observation, intended, in the order of Providence, for its encouragement. Even the lamentable conquests over civilization and refinement which so often threatened the extinction of society, and generally injured the monuments of its progress and industry, were occasionally avenged, and their evil counteracted or remedied by a spirit of admiration which seized on the victors, and urged them to imitate, if it did not enable them to surpass, the vanquished in the arts of peace. The stream that had ceased for a time from the rubbish or sand which interrupted its course, or that had sunk out of sight in the convulsions of its channel, was destined to appear again in a fertilising current, made larger by delay, or become more powerful from the very barriers which opposed it. Such was the triumph which the genius of Greece obtained, at the very time when her arms owned the superiority of a rival, and for ever abandoned the contest for independence.

The Romans, whose whole history was a series of aggressions and conflicts, and whose whole moral and physical efficacy as a nation was concentrated in the sword, had never found leisure from their ambition to cultivate those liberal arts which so much enhance the enjoyments of life. But they had sensibility enough to be smitten with their beauties, when presented to them in the course of their conquests, and the candour to accept instructions from a people that excelled in them, when no longer capable of offering resistance to their lust of empire. Victory after victory extended, indeed, the power of these masters of the world, but more and more confirmed also their intellectual devotion; and at last, when there scarcely remained a single field in which they could assert the superiority of their arms, they found themselves completely subdued in mind by the inhabitants of a small part of their dominions, and that, too, by the agency of objects which their original and long boasted ferocity would have spurned as unworthy the regard of their women and children. The character of the warrior was now irretrievably exchanged for that of the student; patriotic self-denial and contemptuous hardihood were lost for ever in the love of indulgence that follows success and the blandishments of prosperity; the supremacy of intellect, in a word, was clearly established on the ruins of the greatest military power which the world had hitherto witnessed.

Roman taste degenerates.—This extraordinary revolution is more to be rejoiced in as a promise of the ultimate attainment of mind in the progress of mankind, than as quite satisfactory in all the circumstances of taste and judgment by which it was accompanied. In so far as architecture was concerned, these must be allowed to have suffered loss in the grosser conceptions, more hastily obtained acquaintance with the art, and over-abundant wealth which characterised the new votaries. The Romans could not content themselves with the dignified simplicity of their models, but sought additional gratification in meretricious ornaments, and an indefinite variety unknown to their masters. Every device which fancy could suggest or money execute, was hazarded in the indulgence of a luxurious disposition, certainly of much more frequent occurrence than the understanding that knows how to appreciate and rest contented within the limits of attainable enjoyment. Augustus boasted that he had changed Rome from brick to marble. Some of his successors appear to have believed there remained for them no source of similar self-complacency, but the rivalling or exceeding him in extent, magnificence, and profusion of buildings. If more costly materials could have been generally obtained, there existed every disposition for their employment. Ambition had now changed its object among the Romans, who became as zealous in decorating the world as their forefathers had been in destroying it. Humanity rejoiced in this conversion, though taste could not always join in applause. The most distant provinces of their vast empire were visited by their grateful enthusiasm; and those splendid remains of the art which still render some of them so interesting, prove at least the boldness of conception, and the immensity of the means, by which this people endeavoured to secure the honours of their name and character with the remotest generations of mankind. It is no doubt impossible, in contemplating these monuments, not to be struck with the debasement of style which had taken place among them, especially in the decline of their glory, or to deny the absurdity and the extravagance in which many private individuals had indulged to the detriment of the art; but justice must allow, that the liberality of their views, where the public good was concerned, and the spirit by which they were actuated to unite elegance with utility, merit the warmest gratitude, though the result fail to excite the highest admiration. Their mistakes, in point of taste, were almost inseparable from the disposition of mind and feeling with which they first devoted themselves to the fine arts, and the circumstances in which they continued to cultivate them. On the whole, too, considering the very generosity which these mistakes display, and the effect it had on the subsequent cultivation of the art, we should not scruple going a step beyond pardon of the Roman architecture, were it not for the strong conviction, that it is the common and almost invincible propensity of ordinary artists to copy gaudy examples, even without the encouragement which approbation of them bestows.

Roman style renewed.—At the distance of some centuries, the Roman style, a modification or rather a corruption of the Grecian, was revived in different countries of Europe. A veneration for classical antiquity, no longer perhaps thought injurious to the prevalent superstition, and newly wakened by the collision of men's minds which literary and commercial intercourse had occasioned, was speedily extended to those noble edifices which had been the delight and the glory, as they now proved the eulogists of departed genius. Italy, as might be expected, was forward in the work of restoration, and long possessed the finest specimens of its power. France was slow in following the example. Greater ardour and more successful enterprise were shewn in England, in which the genius and skill of Inigo Jones, Sir Christopher Wren, Sir John Vanburgh, and many other eminent men, raised up rivals to the splendid productions of Brunelleschi, Palladio, Vignola, &c. noted as the chief of the Italian architects. Their works had certainly the happy effect of fixing the public taste as to some of the larger description of buildings, on a basis that could be defended by recognised principles, and will probably long retard the progress towards the last stage of corruption, mere sceptical licentiousness.

Contest between Classical and Gothic Architecture.—The principal obstacle which for a time resisted the introduction of the Roman style, in some of the European states, was the existence of a very different species of architecture, which shed an almost solitary ray of scientific consequence on the dark ages. It does not appear to have received the name of Gothic till towards its decline, when the ardent patrons of the revived classical taste bestowed on it that opprobrious epithet as likely to accelerate its ruin, and promote the establishment of their own idol. There is even reason for supposing that this name, which so long afterwards proved injurious to it, when there could scarcely remain a wish on the part of any one that it might be further operative, was at first only accidentally applied to one of the meanest branches of the style, or rather indeed to a species of building of too humble a nature to merit any notice, and that it was afterwards invidiously applied to another object, which though of so high pretensions and undoubted merit, had not hitherto been peculiarly designated. It seems utterly impossible that any one, however warm his affection for another style of building, should have ever beheld a good example of the Gothic, and felt an inclination to vilify it. Nor, so far as we know, is this term, as applied to the style in question, ever used in modern times, without a regret that it is so apt to convey an unjust idea.

The Gothic architecture, wherever it arose, or by whomsoever invented, was, at its appearance in Europe, entirely confined to the structure of Christian churches. Certain peculiarities in its origin perhaps, and a wish to differ in appearance from the remains of pagan idolatry, may have occasioned this restriction. The national establishment, then, of Christianity, had probably some connection with so wide a departure from former style; but there is ground for believing that the change had at least commenced some time before the reign of Constantine, though it did not receive the sanction of the Roman people till about that period. Undoubtedly, as we have already noticed, their style had varied much even before this time, and some of their latest edifices, it is demonstrable, exhibited features to which the characteristics of the Gothic architecture, afterwards established, might claim a degree of affinity. Thus, the arch more especially, of which this people had greatly availed themselves, and which had undergone a variety of forms and duties, may be most satisfactorily traced through the whole progress of the art among them, till the developement of the new style.

The intercourse which a profession of the same faith effected between the capital of the western world, and the inhabitants of the countries of Europe, materially directed, and in fact determined the general taste as to ecclesiastical buildings. Vanity, emulation, and devotional enthusiasm, not to mention the agency of other principles, over which an encroaching superstition had obtained unlimited controul, speedily gave it force, and in a short time filled even the poorest kingdoms with proofs of its love of splendor and power. The influence of Rome, in a word, was again experienced by people in very distant lands, whose insignificance and rudeness might have been expected to preserve them from any such visitations of the mistress of the world.

Various circumstances of a local nature prevented complete uniformity in the churches of different countries, though the identity of the origin of the style, and the common reference which they all had to the same revered models, secured a well marked resemblance. Thus, a certain form in the ground plan, constituting what has usually been called the Latin cross, was universally adopted in the construction of those edifices, and a peculiar arrangement of their more important internal members was almost as generally maintained. Greater latitude of fancy was allowed in the structure of the subsidiary appendages, and the kind and magnitude of the decorations were as numerous as the countries and provinces where the style was displayed. In general, it has been remarked, that the churches of Italy and the adjoining states were most modest in respect of ornaments, which seemed on the whole to augment with the distance from the capital. France and Britain may be said to have vied in profusion of spires, pinnacles, pediments of various kinds, and all the smaller decorations of this most prolific architecture. For comparisons of the most remarkable specimens in these and some other countries, and much curious information as to their history, with hints for determining their respective merits, we must refer the reader to the learned works of Milner, Whittington, &c. before mentioned. We shall confine our attention to a few particulars respecting the progress of this style, and of architecture in general, in our own island.

In Britain.—The Romans founded many cities and constructed a great variety of edifices in Britain. Some of the latter that were erected towards the end of their residence in it, when the religion of the empire had undergone a total change, were devoted to the services of the Christian church. But of their number, precise situations, magnitudes, and style, it is scarcely possible to obtain any satisfactory information. The affairs of this province, owing to the calamities of the Romans at home, had been long very indifferently attended to by the government, and probably were conceived very unimportant by those writers who engaged in the department of history. The Britons themselves had dwindled into insignificance, and had lost their patriotic spirit during a period of mortifying slavery. Few of them appear to have profited by the arts or sciences of their conquerors, and still fewer were either able or inclined to record particulars, which could only perpetuate the remembrance of their subjugation.

These unfortunate people, worthy of a better fate, on the Romans withdrawing from the island, early in the fifth century, found themselves exposed to the continual attacks of their ancient enemies in the north. Their chief concern was to repair and preserve the artificial barriers which some of the Roman governors had formerly thrown up for their defence; and this being insufficient, with such feeble unmilitary troops as they were able to muster, there was no leisure or means allowed them for less important occupations. The monuments, accordingly, of Roman art, were necessarily neglected. Such of them as remained were afterwards exposed to the desolating zeal of the Saxons, whom they called to their aid; but whose barbarity, ungenerous conduct, and peculiar hatred of the Christian religion, were no less injurious than the open and avowed hostility which they had been employed to avenge. Scarcely an example of the ecclesiastical edifices was permitted to testify the piety or taste of the former masters, or to remain as a model for imitation, when the abandonment of their own savageness and superstition, which afterwards took place, brought a new triumph to the Christian name and the cause of humanity. We have a striking description of the desolating conduct of those people in the words of Gildas, a writer who had the misfortune to witness it. The passage is given in Dr Henry's History of Britain. "A fire was kindled by the sacrilegious hands of the Saxons, which spread from city to city, and never ceased until it had burnt up the whole surface of the island, from sea to sea, with its flaming tongue. The walls of all the colonies were beat down to the ground with battering rams, and their inhabitants slain with the point of the sword. Nothing was to be seen in the streets, O horrible to relate! but fragments of ruined towers, temples, and walls, fallen from their lofty seats, besprinkled with blood, and mixed with mangled carcases." This language is no doubt hyperbolical, but it is impossible to dispute the reality of the facts to which it alludes. The island, then, once so embellished with the arts, and noted even in some of the chief places on the continent for the dexterity and skill of its workmen, was fast reverting to a state of ignorance and rudeness, well fitting the character of the people by whom it was now enslaved, and nearly two centuries elapsed before there appeared the smallest reason to hope for its redemption.

Under the Saxons and Danes.—The conversion of the Saxons, which commenced in the reign of Ethelbert, king of Kent, towards the close of the sixth century, and which, in the course of fifty or sixty years, was perfected throughout the heptarchy, formed an era in the history of England, and was marked by extraordinary efforts in the art of building. The policy of the monks, who had been instrumental in the change, pointed out the multiplication of churches and other religious edifices as a meritorious and necessary service, nor was the enthusiasm of the new disciples slack in doing justice to their instructions.

The materials principally used in these structures, at the time of which we now speak, was wood; but there were a few examples of churches composed of a more durable substance. Masonry, or the art of working in stone, appears to have been revived in England about the close of the seventh century. Biscop, or Biscopius, abbot of Westminster, and Wilfred, bishop of York, having frequently visited Rome, and travelled in various parts of Italy and France, acquired considerable taste and much information in it and some of the kindred arts, the practice of which they were enabled to introduce into their own country by means of workmen whom they had brought with them. Several cathedrals, built of stone, and much in the style then prevalent in Rome, were the consequence, besides the instruction of the natives in useful knowledge. But the example was not generally followed for a long period; and accordingly, even as late as the time of Alfred, buildings in stone were by no means common. When that illustrious prince undertook the improvement of his dominions, he was under the necessity of procuring his chief artificers from abroad; and it is pretty certain that the greater part of the many edifices erected by him were constructed of wood.

The frequent and harassing incursions of the Danes, not only retarded the progress of the art, but destroyed also many of its finest productions. That restless people rarely spared any of the churches, monasteries, or other buildings which they happened to meet with in their predatory attacks. As much of Alfred's life had been spent in opposing them, or endeavouring to recover his country from their vexatious power, so a great portion of his labours in architecture was directed to secure his subjects against their future designs. The art of defence was imperiously enjoined, and at first, of course, gave a peculiar character to his valuable undertakings. But the overthrow of his enemies permitting, at last, the full developement of his genius, he manifested the warmest regard for the interests of learning, good government, and commerce, and the highest talents for their effectual encouragement.

Under the Normans.—The Saxon princes who succeeded this illustrious man, appear to have been alike destitute of ability and inclination to copy his example; or if any of them professed either, it is certain that the distressed state of the country, occasioned by the continual and variously successful contests with the Danes, offered little or no opportunity for its beneficial exertion. In course of time, however, and in defiance of many disadvantageous circumstances, the art of building advanced in England. The connexion that had taken place with the Normans, an ingenious and well-informed people, long before the battle of Hastings raised William to the throne so eagerly and so fatally contended for, materially conduced to its improvement, and impressed some striking features on the larger edifices of this period.

The churches erected by this people were divided into three stories, consisting of the arcade, galleries, and windows; and the walls and pillars were made so strong and bulky, that no buttresses were thought necessary for their support. The western front, the decoration of which, it may be remarked, had long been the chief point of rivalship among ecclesiastical architects in general, was furnished with a portico or ambulatory, and the eastern front was made semicircular. The principal door-case shewed pilasters with carved capitals, and over the head of the round arch were placed mouldings of various kinds, as, indented, zig-zag, small squares, beads, &c. &c. The style was distinctly marked by want of harmony in the parts, massive columns, semicircular arches, usually springing from the capitals without the intervention of architraves, by such kind of ornaments as those above mentioned, and, in addition, in later times, by the practice of placing rudely carved figures in bas-relief under the arches of door-cases.

There are few if any entire buildings now remaining, which can be referred with certainty to the Saxon era; but the discriminating ornaments of the style are frequently to be met with. Mr Dallaway particularly points to the nave of the cathedral at Oxford, parts of the cathedrals of Durham and St Alban's, some door-cases and windows at Barfreston, near Canterbury, Tutbury in Staffordshire, Romsey, Hants, and Rochester. "Indeed," says he, "there is scarcely a county in England in which there will not be found individual churches still exhibiting Saxon, or, at least, Anglo-Norman remains. Of the Saxon, Gloucestershire boasts of two very perfect specimens, at Elkstone and Quenington. Door-ways of the early Norman are not unfrequently discoverable in monastic ruins. Those at Glastonbury, Malmesbury, and Castle-Acre priory, Norfolk, are particularly fine." On the whole, the Saxon style is to be considered as a rude imitation of the architecture which had prevailed in Italy after the declension of the art, and which was denominated by the monks, almost the only learned men of those days, 'Opus Romanum,' to designate its origin; and it cannot be doubted, that the intercourse which had long existed between the people of this island and the continent, chiefly on religious concerns, occasioned its adoption; though there be some reason also for the opinion, that certain remains of the ancient Roman edifices had a share in the effect.

Rapid advance after the Conquest.—The period from the conquest to the death of Stephen, that is, from 1066 to 1154, was richer in architectural productions than the preceding age. William I. whose mode of acquiring the throne, and arbitrary principles of government, exposed him to perpetual difficulties with his English subjects, found it necessary to erect many castles and forts, in order to retain his power, and prevent the consequences of their disposition to revolt. The Tower of London, the castles of Nottingham, Lincoln, Huntington, Cambridge, and many other places, are ascribed to his fears, and were scarcely sufficient for their removal. Measures of defence and oppression occupied him too much to allow his encouraging architecture in a different manner. The same remark is to be applied, with little modification, to the conduct of his successors through this period. The spirited opposition which all of them made, with the exception of the weak-minded Stephen, to the policy of the church of Rome and the dominion of the clergy, would have proved unfriendly to its improvement, had not the bishops, and higher orders of ecclesiastical officers, been rather stimulated to extend and secure their influence over popular feeling, in another manner than by their connexion with civil power. They devoted themselves to building, and laid the foundation of that splendid style which has given England so decisive a claim to consequence in the history of this noble art. Thus it is remarked by an author to whose researches we have been so materially indebt-

History.

ed in this treatise, that "no less than fifteen of the twenty-four English cathedrals still retain considerable parts which are undoubtedly of Norman erection." Not to mention many churches belonging to the greater abbeys constructed in this era, few of which unfortunately escaped the general demolition at the reformation, Mr Dallaway, whose words are just now quoted, gives the following enumeration of Norman bishops, who were either architects themselves, or under whose influence architecture flourished. "Gundulf of Rochester, (1077—1107,) whose works are seen at Rochester, Canterbury, and Peterborough. Mauritius of London, (1086—1108,) built old St Paul's Cathedral. Roger of Salisbury, (1107—1140,) the cathedral at Old Sarum. Ernulf of Rochester, (1115—1125,) completed Gundulf's work there; they were both monks of Bec in Normandy. Alexander of Lincoln, (1123—1147,) rebuilt his cathedral. Henry of Blois, bishop of Winchester, (1129—1169) a most celebrated architect, built the conventual churches of St Cross and Rumsey, in Hampshire; and, lastly, Roger, archbishop of York, (1154—1181,) where none of his work remains." Of the churches, the magnificence of which may be merely guessed at from the existing fragments, Mr Dallaway specifies those of Battel in Sussex, Reading and Cirencester, Malmesbury in Wiltshire, Dunstable in Bedfordshire, Castle Acre in Norfolk, Wenlock in Salop, and St Botolph's, Colchester.

A change in style appears to have taken place towards the close of this period, that is, in the end of Stephen's reign. The pillar, which had formerly been massive and single, became more slender, and was formed into clusters; and the arch, in place of being round, acquired a somewhat sharp or pointed appearance. These variations gradually increased, and more and more delicacy of execution, and lightness of proportion, obtained; but the minuter ornaments were preserved with little alteration. The fine style, to which such modifications gave rise, had arrived at great perfection in Henry III.'s time, as is shewn in those noble specimens, Salisbury and Ely cathedrals, and Westminster abbey, the two latter of which have been reasonably enough supposed, from their agreement in the chief proportions, to have been constructed on the same plan. It is improbable, indeed, that the width of the nave in each should have been 72 feet 9 inches, but by concert in the architects.

Discussion on the Origin of the Gothic.—Whence the hint, which occasioned so bold a deviation from the established manner, was derived, has been variously conjectured. Some French antiquaries have contended, that it appeared as early in their country as in England. The remark of Mr Dallaway affords, perhaps, as satisfactory a solution of both points as the nature of the question will admit. "If the Holy Land suggested ideas of this novel architecture, the French croissaders had the same opportunities of introducing it into France as ours into England, for they were associated in the same expedition. It has been said, that in the church of the Holy Sepulchre at Jerusalem no pointed arch was seen, but that in Moorish structures, equally obvious to those adventurers, it is frequent; for which reason it may be more directly described as Saracenic than as Gothic." A similar opinion had been long before maintained by Sir Christopher Wren, who proposed also the title now suggested as preferable to one which all modern writers had agreed to condemn; and it has been ably maintained by Mr Whittington and others, against an hypothesis of Dr Milner, which derives the whole style of pointed architecture from the intersection of semicircular arches, as frequently practised in England, for the sake of decoration, between the close of the 12th and the beginning of the 14th centuries. We cannot do justice to this part of our subject, without stating some of the arguments by which those opinions have been recommended. As most naturally connected with the brief historical view we have already given, and as having illustrated it in part by a series of figures, we commence with the system supported by Dr Milner.

Dr Milner's theory.—In the judgment of this writer, it is needless to have recourse to any foreign country for a discovery the gradations of which can be distinctly traced at home, from its dawn to its perfect completion, and that too among a people whose superiority in arts as well as arms over the inhabitants of those other countries might entitle them to such credit. It is his object, then, to prove that the Normans of the 12th century, especially such of them as enjoyed ecclesiastical distinctions in England, were possessed of this superiority, and that certain peculiarities in the edifices erected by them, had a tendency to lead, and did actually lead to the style of architecture in question.

The people with whom, in refutation of two theories opposed to his own, Dr Milner compares these Normans, are the Saracens, who, at the period adverted to, and for some time after, were in possession of the eastern countries visited by the Croissaders, and the Goths or Visigoths, who, after having conquered Spain as early as the 5th century, and been converted to the Christian faith, had built churches there in imitation of certain appearances of the groves in which they had been accustomed formerly to perform their Pagan rites in their native country, Scandinavia, and who employed in the work Saracen architects, "whose exotic style suited their purpose." As to the Saracens, Dr Milner appears to think they ought to be excluded from the merit of the invention, for two reasons, viz. because, "that throughout all Syria, Arabia, &c. there is not a Gothic building to be discovered, except such as were raised by the Latin Christians subsequent to the perfection of that style in Europe;" and because they did not arrive in Spain until the eighth century, when, "instead of building churches, they destroyed them, or turned them into mosques." With respect, again, to the Goths themselves, no claim set up in their behalf, though aided by the learning and authority of Bishop Warburton, has had speciousness enough to give trouble to the supporters of almost any other theory. But even admitting them to be more considerable, it is evident, from what has already been said, that they derive a great part of their validity from the supposed but disputed ingenuity and good offices of another people. The chief *fact* by which Bishop Warburton's notion is countenanced, for it would be idle to attend to his reasonings or surmises, is the circumstance of some pointed arches being found in the mosque of Cordova, said to have been finished about the year 800. But then, it is not certain that these arches, which are formed by the intersection of two segments of a circle, are really part of the original structure, and it is known that the edifice has been more than once altered by the Mahometans. It would be unfair, therefore, to draw any inference from the fact, till the precise date of its appearance in the present form were correctly ascertained. The existence of pointed arches in the Moorish palace at Granada, called the Alhamba, is still less justly adduced in defence of the same cause, as this building was not erected till the year 1273, when the pointed style may be said to have been established in Europe.

Having disposed of those rival pretensions, Dr M. confidently brings forward his Norman prelates resident in England, as more deserving of notice, and specifies particularly and circumstantially the steps by which they were progressively advanced to the honour assigned them. Among his favourites are Roger of Sarum, Alexander of Lincoln, Mauritius of London, Roger of York, and, above all, Henry of Winchester. The successive improvements of each of these, he tells us, "were of course adopted by the rest," and they all contributed to change the Norman into the Gothic architecture. In what manner they did so, it is of some consequence we should be informed.

The Normans, who affected height no less than length in their churches, in order to obtain it piled arches and pillars on each other, so as at times to form three stories, an example of which is to be seen in Walkelin's work in Winchester cathedral. An imitation of such accumulated masses was frequently practised in the masonry of plain walls; and it was usual by way of ornament, and for the sake of variety, to cause the plain round arches to intersect each other, as may be seen in the upper part of the south transept of the same edifice, which affords probably the first instance of this interesting ornament in the kingdom. It was not, Dr M. thinks, till De Blois, the architect of St Cross, near Winchester, conceived the idea of opening the comprehended spaces for the purpose of windows, that these people were aware of the happy effect of such intersections. The form of both windows and arches now underwent a change; they became long and narrow. This again required the pillars on which they rested to be proportionally tall and slender, and a material of firm texture to be used for their composition. Purbeck marble, generally adopted for the purpose, being found too weak for the weight to be sustained, the shafts were multiplied, and hence arose the clustered column so striking in this style. As the windows, from the manner in which they were formed, were in general very narrow, it was thought necessary at times to place two of them close together, and that frequently under one common arch, of which we have instances in different parts of De Lucy's work in the same cathedral, and in the lower range of the windows in the church of Netley abbey. Such an arrangement, it is obvious, occasioned a blank, or dead space, between the heads of the conjoined windows, which was accordingly planted with a trefoil or quatrefoil, one of the ornaments anciently employed in porches and other places. This kind of decoration soon became prolific. It was the source, in short, of those cinquefoils, circles, squares, fans, Catherine's wheels, &c. so conspicuous in Gothic windows. Such ornaments were not long confined to their original situation. They were applied also to the pointed arches on the outside of buildings, which frequently were made to terminate in a trefoil. The buttresses even, that were erected externally in aid of the walls, must have their appropriate pinnacles similarly beautified; and the pinnacle again, still advancing in the mighty effort of ambitious improvement, became at last a spire. "Thus, we see, how naturally the several gradations of the pointed architecture arose one out of another, and how the intersecting of two circular arches in the church of St Cross may perhaps have produced Salisbury steeple."

Such then is the theory, in few words, which Dr Milner has advanced in his Essay "On the rise and progress of the pointed arch," contained in his History and Survey of Winchester," to which we must refer for information as to the facts and reasoning brought forward in its support. Before proceeding to consider a very different theory, we have to notice a distinction endeavoured to be established by the same author, in the manner or appearance of this style. According to him, the Gothic architecture is as susceptible of a division into orders as the Grecian, and these are also three in number, each of which is essentially characterised by the degree of inclination of the lines forming the pointed arch.

Different orders of Gothic.—In the *first order*, the arches are very acute, and the pillars for the most part heavy and massive, such as are found in Saxon or Norman buildings, but sometimes having a faint resemblance to the clustered column, groins of simply intersecting ribs, and windows without mullions, or having only a single bisecting one, and ornamented with a single trefoil, quatre-foil, or other simple flower. The east end of Canterbury cathedral furnishes an example. We have other instances in the cathedral of Lincoln (the west end), Salisbury throughout, and in the transepts of Westminster and York. This order is to be traced from about the beginning of Stephen's reign, till near the end of the 13th century.

In the *second order* are exhibited arches, forming an equilateral triangle, clustered columns generally formed out of one stone, and having what are called historic capitals, windows magnificently enriched with a variety of ornaments, decorated groins, mullions reaching to the bottom of their story, shafts of the main cluster supporting the springers of minute arches, &c. all indicative of a grandeur and freedom bordering on luxuriance, but withal extremely delicate and pleasing. There are noble specimens in the choir and nave of Yorkminster, the naves of Westminster, Canterbury, Winchester, Exeter, and St Stephen's Chapel, Westminster. This order prevailed from the end of the 13th to the middle of the 15th century.

The *third order* is easily discriminated by its depressed obtuse angled arches, pendant capitals, greatly perforated walls, and an extravagant profusion of tracery and other fanciful decorations, much more calculated to excite surprise and a feeling of perplexity, than to gratify a refined and correct taste. This order, which has justly enough been considered as marking the decline of the style, reached from the end of the 15th to the middle of the 16th century. It is to be seen in Henry VII.'s chapel, Westminster, certainly a most extraordinary production, King's College chapel, Cambridge, and St George's chapel at Windsor.

The sum of Dr Milner's opinions, then, may be given in a short compass. The pointed architecture grew out of the simple pointed arch, between the end of the 12th and the early part of the 14th century. The pointed arch itself was discovered by observing the effect of those intersections of semicircular arches which preceding artists employed to ornament ecclesiastical edifices. We are indebted for both discoveries, that is, for the origin and cultivation of the pointed style, to our own ancestors, the Anglo-Normans and English. Lastly, There are three orders of this style, as plainly distinguishable from one another as the orders of the Grecian architecture, and having their respective members, ornaments, and proportions.

Mr Whittington's theory.—For a very different view of the whole subject we shall have recourse to a recent publication by Mr Haggitt, rector of Ditton, Cambridgeshire, who ably supports Mr Whittington's sentiments. According to Mr W. the pointed arch existed in France before the 12th century, and that not accidentally, or by way of ornament merely, but as an *integral part* of several structures, and constituting a prominent feature in them; the pointed style, therefore, could not have its origin at the period assigned by Dr Milner, or be discovered in the manner and place which he has specified. It is endeavoured, in short, to make it appear, that the French had attained to a high degree of perfection in this style, half a century before the English had constructed any similar work of *comparative* excellence, and that consequently the latter are not at all entitled to the merit which Dr Milner awards them as its discoverers and earliest promoters. The evidences of this fact, cited in Mr. Whittington's work are these four examples of the pointed arch: 1st, The *crypt* of the abbey church of St Denis, which was completed by Charlemagne as early as the close of the 8th century; 2dly, The eastern end of the choir of the abbey church of St Germain des Pres, finished at the beginning of the 11th century; 3dly, The choir of the Benedictine church of la Charité sur Loire, completed before the close of the same century; 4thly, The chapel of the Apsis, and some part of the eastern arcade of the church itself of St Denis, which were the work of abbot Luger in 1144. The greater part of this last edifice was rebuilt in 1231; but as the pointed arch is visible in every part of what remains of the ancient work, it is with propriety brought forward as a legitimate example. Other evidences of a similar kind, it is believed, might have been mentioned; but the caution and scrupulousness of Mr Whittington would not suffer him to advance any instance which he was unable to substantiate by a distinct record. These four may be judged sufficient, especially when it is considered that Dr Milner himself appears totally at a loss to discard them. The last of them, indeed, is the only one with which he attempts feebly to contend. Even giving it up, then, it seems to follow of necessity, that "the pointed arch existed in three important edifices of France before it was known in England."

It is to meet this decisive conclusion that Dr Milner tells us of examples of pointed arches formed by intersection, and introduced as ornaments upon the walls of English churches in the 12th century. But at all events these correspond as to date with the last only of Mr Whittington's four examples; and then they are not instances of the pointed arch used as an essential feature, but are mere decorations which may be proved to have been "common to the Lombard churches of that and of a still earlier period through a great part of Europe." Whereas, on Dr Milner's own hypothesis, two out of the three admitted examples adduced by Mr Whittington, are full and complete instances of the Doctor's *first order of the pointed style*, that is to say, such instances of it as the choir of Canterbury, which was not built till nearly two centuries after the first of the churches alluded to, and one century after the second. Before concluding this part of our statement, it is incumbent on us to mention another example of the priority of the French in the use of the pointed arch, to be added to the four already specified. It is the abbey church of Clugny, begun in 1093, and finished in 1131, of the interior of which Mr Hawkins has given two views in his work on the History, &c. of Gothic Architecture, lately published. The opinion is a very probable one, that Henry de Blois, who afterwards exhibited the pointed arch in his hospital of St Cross, as was formerly remarked, actually acquired his knowledge of it during his residence in this abbey, where he passed his early years as a monk, at the very time that the church belonging to it was erecting. A presumption, at least, thence arises, as to the introduction of this style into England, which a warm partisan could scarcely fail to cherish. Nor is it immaterial, perhaps, to notice, that the church of Notre Dame in the capital of France, entirely a Gothic building, was begun in 1161, and was so far completed in 1181 as to be consecrated by the Pope's legate.

Probably derived from the East.—But clearly as we think it may be demonstrated, that this style was adopted in France sooner than in England, we see no reason to imagine that it originated in that country. This leads us to make a few remarks on the probability of its having been received from the east in the course of the Crusades.

In the first place, then, if we except a few desultory instances of pointed arch, which, it is not unlikely, were suggested by the information of some of the earlier pilgrims to the Holy Land, it is very certain that none of the principal features of this style existed in Europe anterior to the time of the first crusade, which ended with the capture of Jerusalem in 1099. In this expedition few of the English were engaged, and but a small part returned to their native country. A similar observation is to be made respecting the second crusade, which took place in 1146, under the guidance of the Emperor Conrad and Louis the Seventh. It is not certain, indeed, that any English force was associated in it. Not so, however, in the third crusade, which commenced in 1191; there Richard I. and many of his subjects acted a conspicuous part.

In the second place, this style appears to have arisen in different countries of Europe during the course of these expeditions, and that, too, very much in the proportion and order in which they were engaged in them. Thus France exhibited various instances of it soon after the termination of the second crusade, but England not till after the return of Richard from the third; a difference which the circumstance above stated may be allowed to explain. It is indeed a very important fact in this question, as is noticed by Mr Haggitt, "that during the last twenty years of the 12th, and the first thirty years of the 13th centuries, Gothic architecture arose and flourished in all the principal countries of Europe; in France, in Germany, in the Low Countries, in Spain, in England, in Italy, and in Sicily;" and it certainly appears something more reasonable to ascribe so general an adoption of it to the influence of an agent common to the whole, than to imagine what, on any view of the matter, is not susceptible of proof, that one of these nations having invented the style, became the pattern to which the others conformed. It is almost inconceivable, in reality, that this latter could have been the case, and yet that there should exist no historical evidence by which it can be substantiated.

Thirdly, If there be reason to determine that the principal features of the pointed style existed in the East previous to those expeditions, it will appear very probable, the two preceding circumstances being taken into account, that this mode of architecture was one of the consequences resulting from them. The proof of this fact, indeed, is almost decisive of the controversy. Dr Milner, aware of this, is shocked at the idea of deriving so beautiful and ingenious an art from the "ruthless Saracens," and attaches unlimited confidence to the negative incident of Pococke, Norden, and Shaw neither making mention of pointed arches, nor giving representations of them in their accounts of those eastern countries which they had visited. Mr Haggitt, on the other hand, establishes the competency of this people, from their general character in history as the cultivators of the arts and sciences, and the well-known magnificence and number of their architectural productions; and he both accounts for the silence of the travellers just now mentioned, and opposes to it the direct and positive testimony of more recent observers. In our judgment he has completely succeeded in both points; and accordingly we have not the shadow of a doubt, that the chief features of the pointed architecture, as a style, are really to be found in the East. An impartial reader of Mr Haggitt's Second Letter cannot resist this conclusion; and hence the only remaining question to be determined respects the antiquity of the monuments which display them. Here, too, it appears, that the evidence adduced by this gentleman is entitled to high consideration, if not productive of entire conviction. On the whole, then, we do not hesitate to award the full amount of his claims in behalf of the opinion he has espoused, or to admit the correctness of his concluding statement as to the success of his inquiries. "I have shewn," says he, "that there is at least no moral improbability in the eastern origin of pointed architecture: I have endeavoured to account for its not appearing in this island sooner than it did appear, and for its introduction at the termination of the *third crusade:* I have also shewn, that remains of pointed, or Gothic architecture, actually exist in Syria, Palestine, and Egypt; and that there are strong reasons for assigning some of those remains to an age long anterior to the crusades."

Before concluding this subject we may suggest, that though his opinions as to the relative times of its appearance be disproved, yet the idea of Dr Milner respecting the mode in which the pointed arch originated, is quite reconcileable with the fact of its superior antiquity both in France and the East. It is rather strange that this remark has not been made before by any of the combatants. But we are far from deciding as to its correctness. Another observation occurs, perhaps no less entitled to respect. May not the pointed arch have resulted from the substitution of several pieces, in place of the two rafters or stones opposed to each other, in the manner described when speaking of the origin of the arch, after the safety and the beauty of the circular form had attracted so much regard as to modify the existing taste? This opens a field for inquiry, as far as we know not yet entered on, and might carry back the principles of Gothic architecture to a still earlier period than the theories now stated have assumed. The reader will find an interesting series of comparisons between French and English cathedrals, &c. in Mr Whittington's work. Mr Dallaway's Observations on English Architecture will supply him with many curious particulars respecting the latter.

English style varies.—The equally clustered column with a low sharp arch, prevailed in Edward III.'s time. The chapel of Our Lady, attached to Ely cathedral, is a fine specimen of the style of this period. Becket's Crown, in Canterbury cathedral, probably suggested the idea of the Louvre of Ely and Canterbury. To the crosses erected by Edward I. in honour of his consort, has been attributed the introduction of the elaborate canopies and minute decorations of tombs and shrines. These ornaments soon became excessive. The earliest example of this sort of workmanship, generally termed "filligraine," is the choir of York cathedral. Additional embellishments were sought about the middle of the 15th century, some of them abundantly whimsical and capricious, as may be seen in the armorial ensigns of honour on roofs, and the spandrils of internal arcades. They were also commonly appended to market crosses and the gateways of abbeys. Crosses answered, in these times, the double purpose of devotion and commerce, and it was the fashion to adorn them in the most luxuriant manner. That particular style which has been properly enough denominated the "Florid Gothic," seems to have prevailed from the beginning of the reign of Henry IV. to the end of that of Henry VII.; and it is no doubt a singular circumstance, that architecture flourished so extensively during the tempestuous times of the wars between the houses of York and Lancaster. Of the edifices of this period we may mention the choir of Gloucester, the sepulchral chapel adjoining the parish church at Warwick, that at Westminster, King's chapel at Cambridge, the royal chapel at Windsor, and the abbey church at Bath, which, though finished a little later, is properly referred to this era. The reformation, it need scarcely be told the reader, destroyed more edifices than it spared. How great, then, reckoning from the number and kind of those which remained, must have been the zeal, and intelligence, and taste, which animated and directed the pious patrons of English ecclesiastical architecture!

The reign of Henry VII. in which the basis was laid of a firm and undisputed government, was peculiarly favourable to this art. It has been termed, indeed, the grand æra of handsome parochial churches, which sufficiently signalizes the amount and kind of service given. The style, though becoming gradually more venturous and indulgent, was hitherto unmixed. In the succeeding reign, particularly towards its close, a combination of Gothic and Grecian manners was destructive of the real beauties which either possessed separately. The proper remedy for the evil was discovered long after in the revival of classical architecture, as recommended by the learning of Sir H. Wootten, and illustrated by the genius of Inigo Jones and his disciples.

Progress in Scotland.—Here we may make a remark or two respecting the progress of ecclesiastical architecture in Scotland. This country, it is probable, had not so much as one stone church at the commencement of the 8th century. But a wooden church built on the island of Lindisfairn, in Northumberland, A. D. 652, is said to be constructed *more Scotorum*, from which it may be inferred that this people were well acquainted with the use of other materials at this period, Naitan, king of the Picts, applied by letter to the abbot of Weremouth, A. D. 710, for the assistance of masons to erect a stone church in his kingdom, and his request, Bede tells us, was granted. The churches of Old Melrose, Coldingham, and Tynningham, are imagined to have been among the first buildings of the kind in this kingdom. The art did not prosper much till the reign of David I. when it was carried on to a greater degree than the poverty of the country might seem to have allowed. No less than twelve considerable edifices, destined to religious purposes, have been ascribed to this prince, amongst which are the four cathedrals of Glasgow, Dunkeld, St Andrew's, and Aberdeen. These, and the other buildings now alluded to, were probably all erected between 1125 and 1154, a striking fact in the concerns of so small a state, and not paralleled, we believe, in any other period of its history. Of the subsequent structures of this kind may be mentioned the abbey of Aberbrothwick, founded in 1178, the Pluscardine priory in Moray, 1230, and the collegiate churches of Dunbar in 1342, Dunglas, 1403, and Roslin, 1446. "Of Gothic architecture in Scotland, (says Mr Dallaway,) the most beautiful pieces which remain entire are Melrose abbey, (rapidly decaying, alas!) the cathedral at Glasgow, Lincluden college, near Dumfries, the chapel at Roslin near Edinburgh, and that in the palace of Holyrood, (now a ruin,) the last mentioned of which was founded about 1440, by king James II. of that realm. Their sides are flanked by flying buttresses, like those at Westminster, but with a happier effect, because in a purer style."

Progress of Castles, &c. in Britain.—The history of castellated and domestic architecture in Britain, demands some notice. The Romans built many military structures in the various provinces which they had conquered, and of these, it is probable, the Saxons, who succeeded to them, availed themselves, in order to retain possession of the country. Long acquaintance with the feudal system had accustomed the Normans to the notion that a castle was essential to every large estate. This did not abandon them on their coming over to England, as is evident from the numerous remains of their fortresses still to be met with. The chief peculiarity in these buildings is the *keep*, usually a square tower of great height, or a circular one much lower but of considerable diameter, and accessible by steep stone stairs. The walls, which were of great thickness, admitted a winding stair-case, galleries, and chimnies, the oven, the well, &c. and had an opening at top for the admission of light and air to the dungeon at the base, in which it was customary to confine prisoners. The ground-floor was without light; the second obtained it through small loop-holes; but the third, in which was the state apartment, had the benefit of large round-arched windows, so contrived as not to be looked through from within, nor penetrated by missile weapons from without. Various contrivances rendered these forts tolerably secure, even after the adjoining buildings were either taken or destroyed. Famine, of course, proved an invincible opponent. Gundulph, bishop of Rochester, after the conquest, is said to have contributed much to the strength and beauty of the established mode of defence. His plans were gradually improved in subsequent times, especially in the period between the reigns of the second and third Henry. But the chief amendment was owing to the observations which Edward I. made during his crusading visit to the Levant and the Holy Land, where the architecture of defence had arrived at great perfection. The castles of Caernarvon, Conway, Harlech, and Aberystwith, all in Wales, were erected by this prince. Scarcely a vestige of the last is discoverable, but the others still claim admiration. Many other castles in this territory had their origin in the resolution of Edward's chief followers to preserve the divided fruits of his successful invasion.

Hitherto, and for some time after, the principal object aimed at in these fortresses was impregnability. The reign of Edward III. presented a new feature, in a degree of elegance and habitable comfort, to which former generations were strangers. The example of this monarch at Windsor, may be said to have excited a rivalry among his barons, many of whom were the abler to engage in it, in consequence of the wealth acquired by the ransom of prisoners taken in the battles of Poictiers and Cressy. The improvements now alluded to were continued and extended to the time of the termination of the contests between the houses of York and Lancaster,—a period rich in castellated edifices, whose ruins now form an interest of the highest kind in many of our choicest landscapes.

In the tranquillity that succeeded this long dissension, the forbidding features of the castellated style became less striking, greater regard was paid to embellishments, and those baronial mansions which still retained a military appearance, displayed, at the same time, the magnificence and convenience of private dwellings. Domestic and military architecture, in short, were blended together in various degrees throughout the reign of the Tudor family, the increasing security of the public peace at last giving preponderance to the former, which in many cases merely acknowledged a kind of relationship with the latter by its useless battlements, insignificant parapets, turrets, &c. &c.

The employment of brick in place of stones of various kinds, is perhaps nearly coeval with the conversion of castles into commodious houses, and became more common as the necessity for defence diminished. But in certain parts of the country the abundance of the latter material decided. It has been supposed that the use of brick, which was so frequent with the Romans who resided in England, was not revived till the reign of Richard II. The walls of the feodal castles of early times were commonly faced only with hewn stones, the intermediate parts being filled up with pebbles, rubble-stones, &c. Flints squared in a particular way were often used for outside walls, especially in Henry VII.'s time. When the condition of public affairs permitted a regard to internal decorations, it became usual to cover the walls of state chambers with wainscot, which was either painted in fresco, or hung with arras or tapestry. The large halls also, which formed an essential part of the castles, afforded a favourite subject for ornament. In painted glass, carvings of different kinds, and all sorts of beautifying contrivances, some castles are supposed to have vied with the churches of the same period.

Revival of Roman style in Britain.—The partial introduction of the Roman style, about the middle of the 16th century, co-operated with the change of manners attendant on long tranquillity, in occasioning an abandonment of the peculiarities of the military architecture. Holbein took the lead in this transformation, confining himself chiefly to the porticos and portals of houses. He was followed by John of Padua, who built Somerset-house and Longleat, both in a mixed style. The first house, entirely Italian, according to Mr Dallaway, was erected by Sir Horatio Palavicini, at Little Shelford, in Essex. Queen Elizabeth's reign produced several respectable architects and many magnificent houses. Of the more remarkable productions which appeared towards the close of the 16th, and the commencement of the following century, may be specified, Burleigh-house, Audley-end, Holland-house, Campden-house, and Knowle. Mr Dallaway has well described the peculiarities in the style of this period. "The vast dimensions of the apartments, the extreme length of the galleries, and the enormous square-windows, are the leading characteristics of the manner of building during the reigns of Elizabeth and James I. The ornaments, both within and without, were cumbrous, and equally void of grace and propriety. Nothing could exceed the heaviness of the cornices and cielings, wrought into compartments, or the awkward intersection of the passages. The hall retained nothing of the Gothic description, excepting its size and bay-window; being very frequently merely a large room, including the whole space of the house from the base to the roof. Instead of battlements and pinnacles, the parapet was broken into numerous pediments, not exactly conical or angular, but of a form too capricious for description."

Modern innovations.—This heavy style of building, which distinguished the reigns of Elizabeth and her successor, gave way to the lighter taste and chaster conceptions of Inigo Jones and his scholars. To their influence on the public mind, in recommending the adoption of classical architecture, we owe much of that elegance and highly-wrought convenience so conspicuous in modern English houses. Their labours, it is probable, would have proved more immediately important, had not the distressing calamities which afterwards afflicted the kingdom afforded more imperative considerations. Many of the edifices ascribed to Inigo Jones were finished from his plans, though not built under his own notice. Of his genuine works may be mentioned Stoke-park, in Northamptonshire, Castle-Ashby, Charles I.'s picture gallery at Whitehall, the Queen's house in Greenwich-park, Lindsey-house in Lincoln-Inn Fields, the Grange in Hants, and the Banqueting-house at Whitehall.

The restoration of Charles II. seems not to have been propitious to architectural purity. Some very injudicious attempts were then made to reconcile the Gothic and classical manners. The principal architects, in general, possessed more science than taste. An intimate acquaintance with the fine models of antiquity was required to correct their judgment as to the sources of the beautiful in the art. But it was long before this remedy was any way effectually applied. The names of two noblemen, Pembroke and Burlington, enlightened patrons of the art, merit distinction for their contributions towards its improvement, as well as those of Wren and Vanburgh for their official services. Lord Leicester, in a subsequent period, seems to have possessed equal refinement and strength of conception. Indeed, for sometime, the chief improvements in our national architecture were owing to the classical studies of persons who were alike removed from the prejudices of professional men, and the necessity of accommodating themselves to public opinion. We have still more recent examples of the same truth.

Present state.—Greater intimacy with ancient models, principally effected through the labours of Wood and Dawkins at Palmyra and Balbeck, Stuart, Revet, and others, in Greece, &c. has occasioned the abandonment of the debased Roman manner; but the Gothic and mixed styles are still in repute. The recent discoveries in some of the subsidiary sciences have materially influenced the internal arrangement of houses, whilst a judicious regard to what may deserve the name of salutary luxury, and perhaps a still greater regard, not so commonly justifiable, to splendour of appearance, together with the perfect absence of every defensive idea, have been productive of an amplitude of dimensions, and a boldness of aspect quite unknown to former times, and, as far as we know, to other countries. It would be easy, indeed, in the political history of Europe for the last half century, to point out reasons why architecture has been more highly cultivated in Britain than in any other kingdom. We are not aware of any causes likely to arrest its progress; nor do we apprehend its deterioration, unless from an evil agent, to which we have more than once alluded, but against which we are furnished with an effectual security if we chuse to avail ourselves of it, in the perpetually renewed display and diligent study of those models of harmonizing beauties, which so many generations of mankind have willingly agreed to admire.

Explanation of Plates.

Plate 11. Fig. 1—9. illustrate the strength of materials; Fig. 10. the construction of arches; Fig. 11—21. the constructions of roofs; Fig. 22. a Norman roof.

Plate 12. Fig. 1. The old roof of St Paul's church, Covent-Garden, London; Fig. 2. The new roof; Fig. 3. The roof of Islington church, near London; Fig. 4. A proposed improvement on the same roof; Fig. 5. Roof of the chapel of Greenwich hospital; Fig. 6. Roof of Birmingham theatre; Fig. 7. Roof of Drury-lane theatre; Fig. 8. and 9. Parts of its construction; Fig. 10. Remarkable roof of the Riding-school, St Petersburgh; Fig. 11. Dome of St Paul's, London; Fig. 11, 2d.—20. Illustration of the construction of wooden bridges.

Plate 13. Fig. 1—8. Construction of the centering of different bridges; Fig. 9. Sunderland bridge.

Plate 14. Plan and elevation of different bridges; the wooden bridge over the Don, near Aberdeen, consists of a single arch of 109 feet span; the three ancient Roman bridges are in Rome or its vicinity; the bridge of Orleans in France, designed by M. Hupeau, and remarkable for its simplicity and elegance, consists of nine arches; the middle arch is nearly 107 feet span, with a rise of 30 feet, the arches next the abutments have 98 feet span and 26 feet of rise, and the remaining arches are in proportion. The whole breadth, including the parapets, is 49 feet. This fine bridge was begun in 1750, and was finished in ten years.

The bridge over the Tay at Dunkeld, which is reckoned one of the finest in Scotland, consists of five large arches, and two on the land sides of a smaller description. The middle arch is 90 feet span, with a rise of 30 feet. The breadth over the parapets is 27 feet.

The Strand or Waterloo bridge over the Thames at London consists of nine arches, of 120 feet span each. The piers are 20 feet thick; the breadth within the parapets is 42 feet; the road-way is 28 feet broad, and the footpaths are seven feet broad each. A considerable part of the foundations of the piers and of the arches is built with the fine sandstone from Craigleith quarry near Edinburgh. Other parts are constructed of Cornish granite, and the outside or casing of the entire structure is of the same material, but the balustrades are formed of the beautiful grey granite from Aberdeen.

Plate 15. Fig. 1. Shews the different parts and divisions of a column and entablature in the Tuscan order; Fig. 2. Illustration of the Doric order; Fig. 3. Character and dimensions of the Ionic order; Fig. 4. Character and proportion of the Corinthian order; Fig. 5. The Composite order.

Fig. 6. 7. 8. 9. 10. 11. 12. Illustration of Sir James Hall's theory of the origin of Gothic architecture.

Fig. 13. Arched entrance to the north aisle of Peterborough cathedral, illustrating the Saxon capital and *chevron work* or zig-zag ornaments.

Fig. 14. An arch in Norwich cathedral, adorned with *billet*-moulding, and a spiral band on one of the columns.

Fig. 13. 14. 15. 16. 17. illustrate the origin and progress of the pointed arch.

Plate 16. Fig. 1. St Paul's, Covent Garden, London, which is reckoned a good example of the Tuscan order. No ancient specimen is known.

Fig. 2. Doric portico at Athens, with four fluted columns, supposed by some to be the remains of a temple dedicated to Rome and Augustus, but by Mr Wilkins to be the entrance to a market-place. This is esteemed one of the best examples of the ancient Doric order applicable to private edifices.

Fig. 3. Temples of Erectheus, of Minerva Polias, and Pandrosus, at Athens; A, the temple of Minerva, at other end of which is the temple of Erectheus; B, is the portico of both temples. The temple or cell of Pandrosus is adorned with caryatides, one of which, supporting the corner of the entablature, was removed by Lord Elgin, and is now in the British Museum. This fine example of the ancient Ionic is copied in the portico of the county-hall, now erecting (1816) in Edinburgh.

Fig. 4. An example of the Corinthian order, taken from the remains of the temple of Jupiter Stator at Rome, which is greatly celebrated for its rich decorations.

Fig. 5. View of an ancient Sarcophagus.

Fig. 6. Amphitheatre at Pola in Istria, of an elliptical form. The length is 436½ feet, the shorter diameter is 346 feet, and the height about 100 feet, and is divided into three stories.

Fig. 7. The Trajan column at Rome is seen in the distance.

Plate 17. Fig. 1. Temple of the Winds at Athens, is constructed of marble, and of an octagon form, on each side of which is sculptured an emblematical representation of the wind which blows against that side, and on the top was a conical piece of marble, and surmounted by a triton, holding a wand in his right hand, so contrived that the wand points to that side from which the wind blows. The roof of this building is remarkable for its elegance. Under each of the figures, which are fine pieces of sculpture, is a sun-dial; and

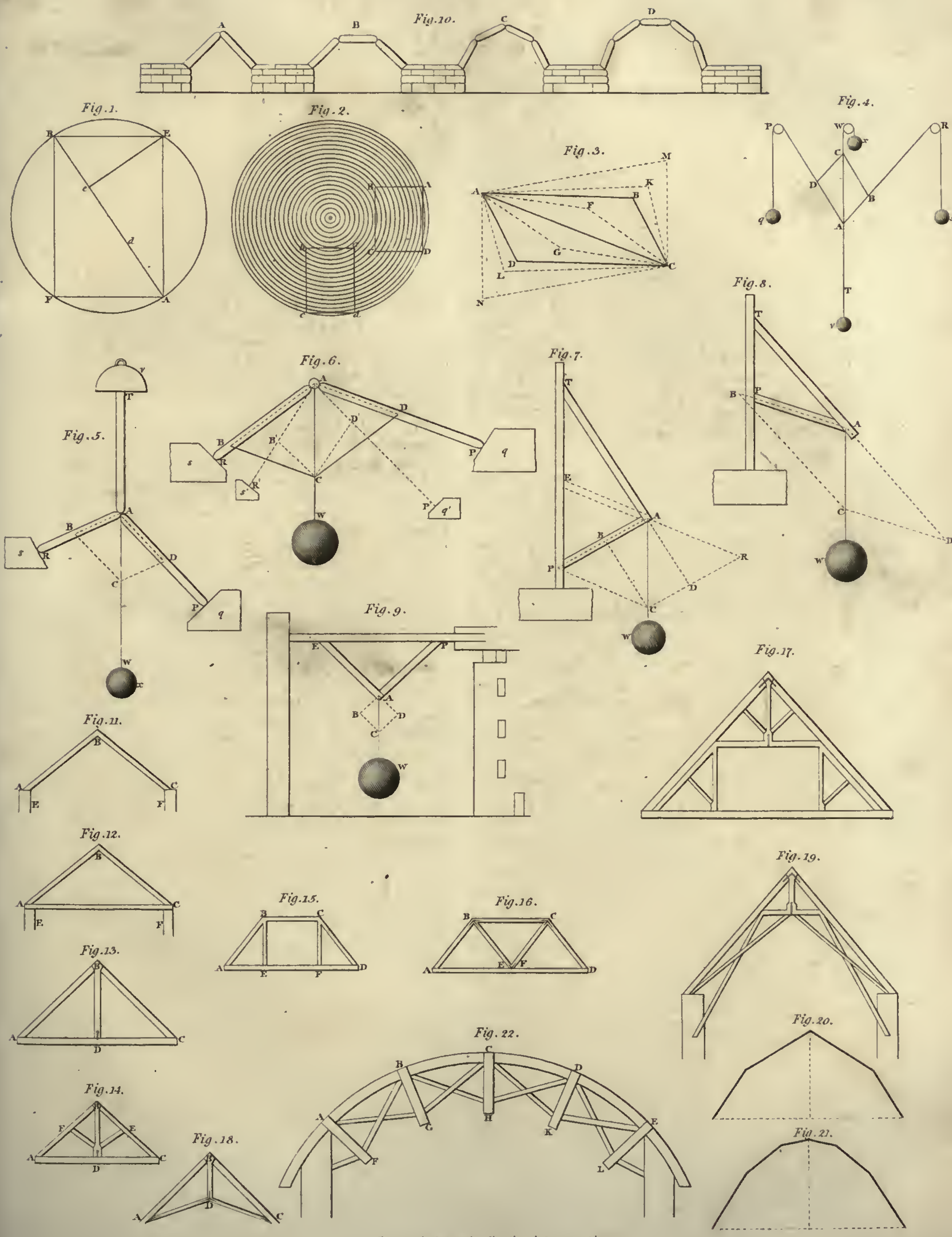
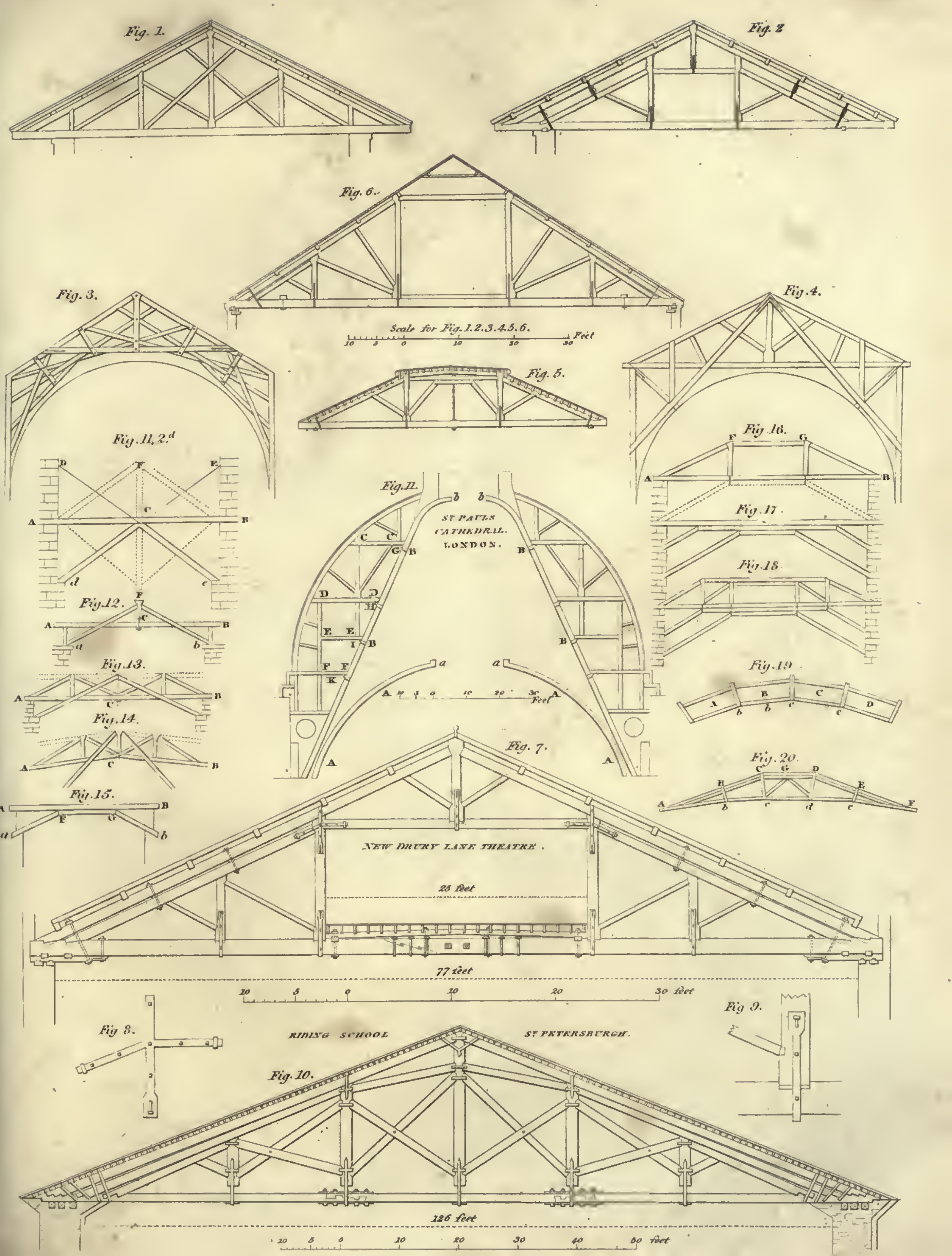


Fig. 10.
Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 11.
Fig. 12.
Fig. 13.
Fig. 14.
Fig. 15.
Fig. 16.
Fig. 17.
Fig. 18.
Fig. 19.
Fig. 20.
Fig. 21.
Fig. 22.

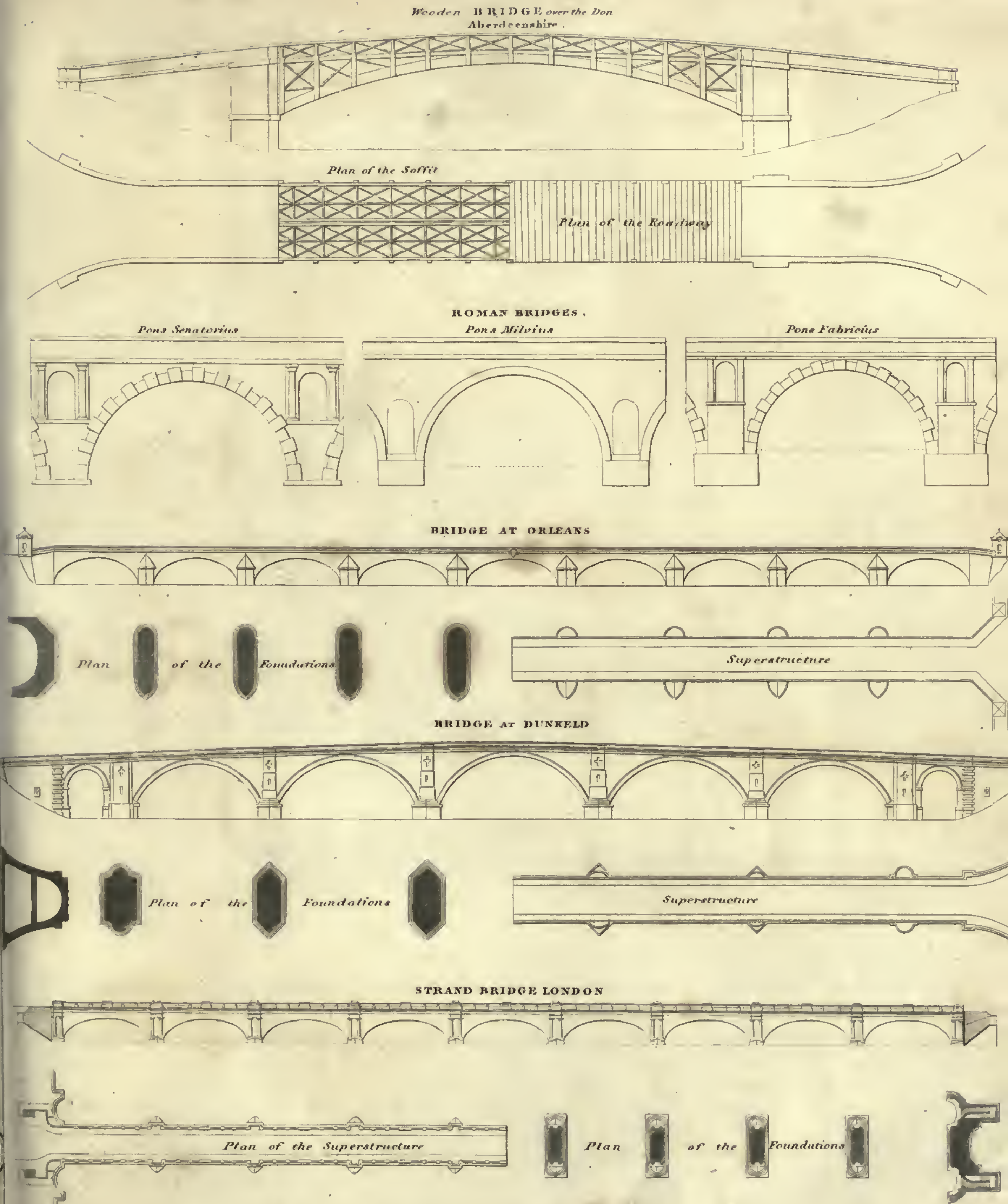
ARCHITECTURE.

PLATE I

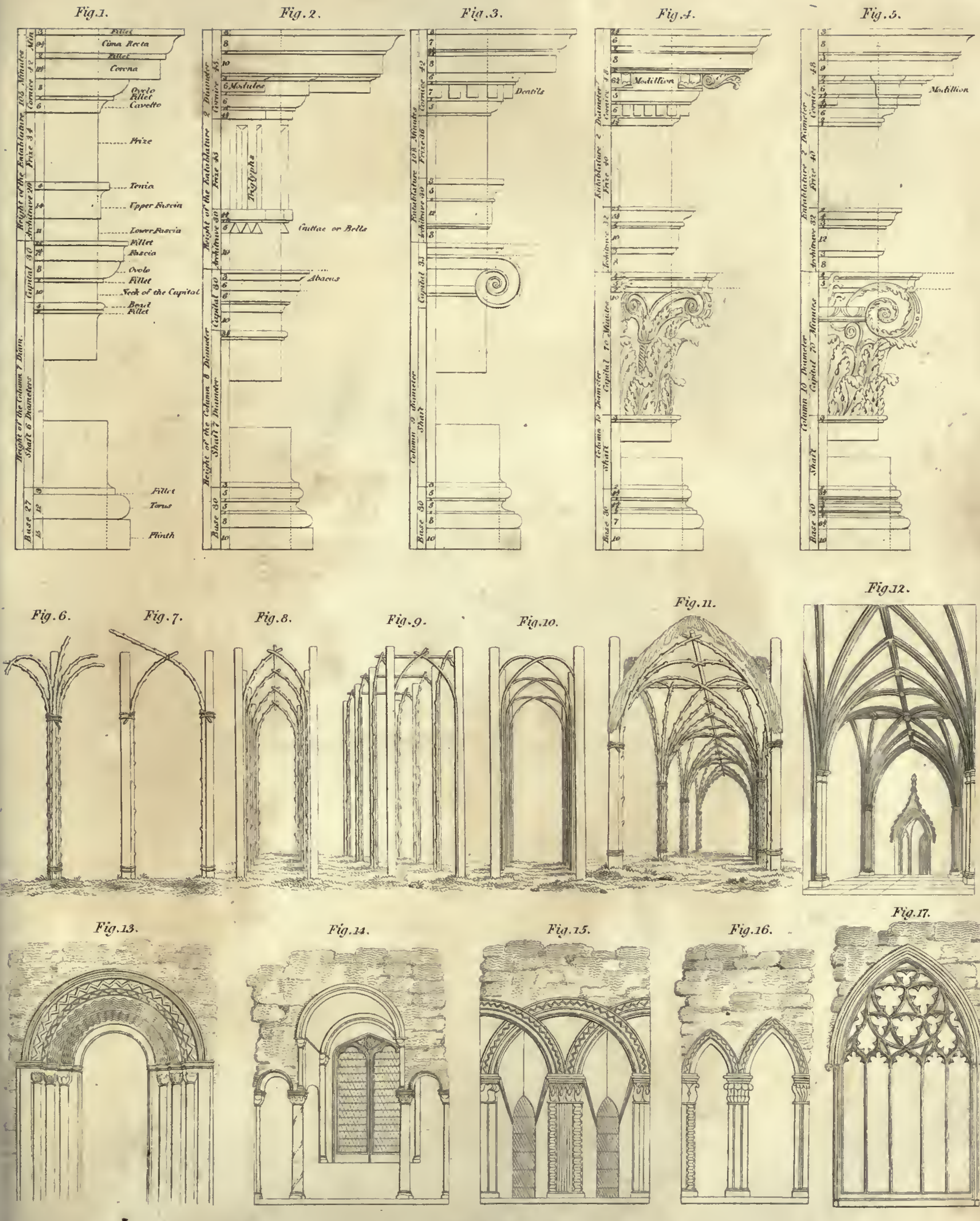


Engraved for the Encyclopædia Edinensis by W. & D. Lizars Edin^r

SUNDERLAND BRIDGE.



Drawn & Engraved for the Encyclopaedia Edinensis by W. & D. Lizars Edin.



Drawn & Engraved for the Encyclopædia Edinensis by W. & D. Lizars Edinburgh.

ARCHITECTURE.

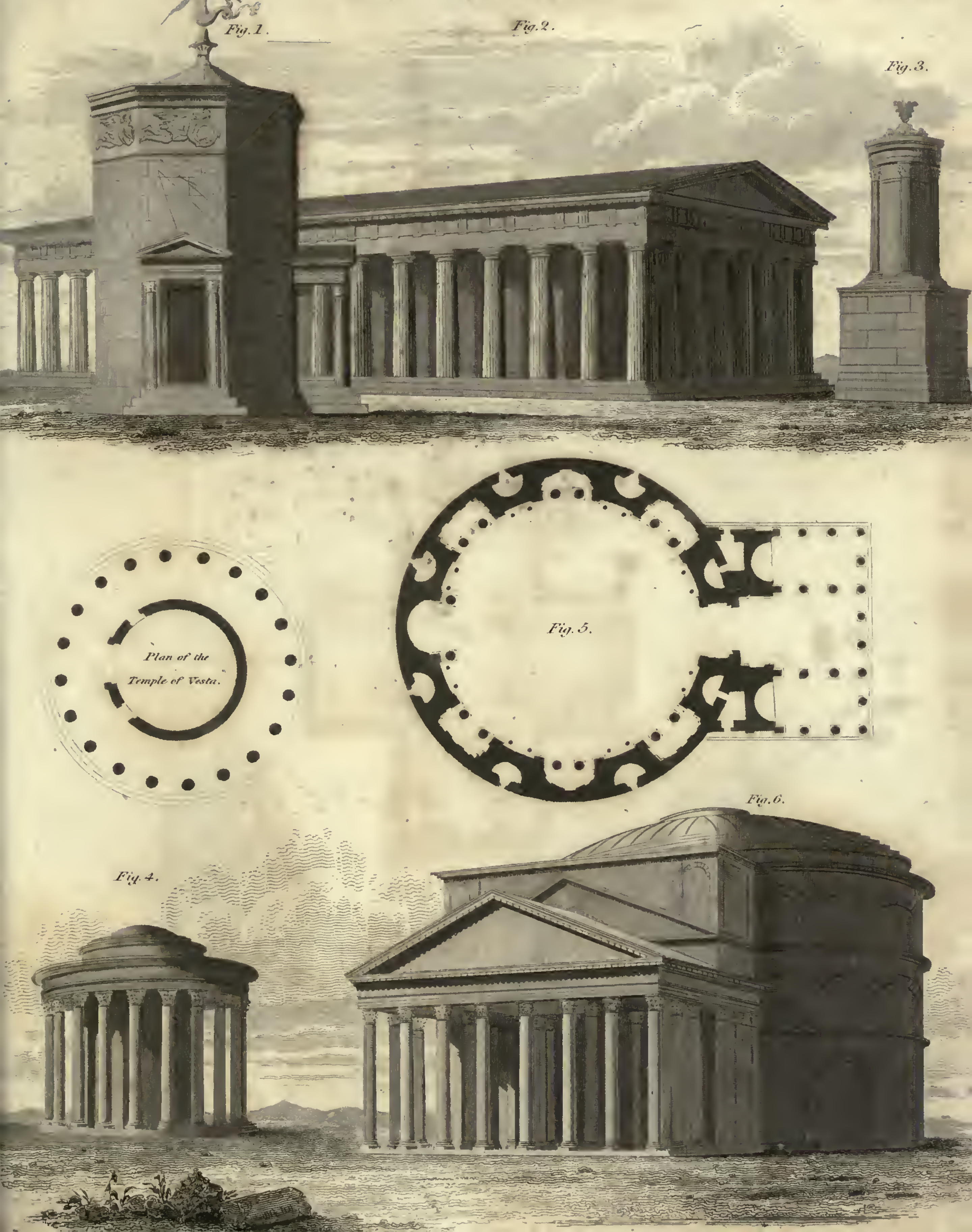


Fig. 1.
Fig. 2.
Fig. 3.
Plan of the Temple of Vesta.
Fig. 5.
Fig. 6.
Fig. 4.

PERSPECTIVE VIEW OF THE COURT-HOUSE, PUBLIC OFFICES, AND GAOL OF GLASGOW.

Fig.1.

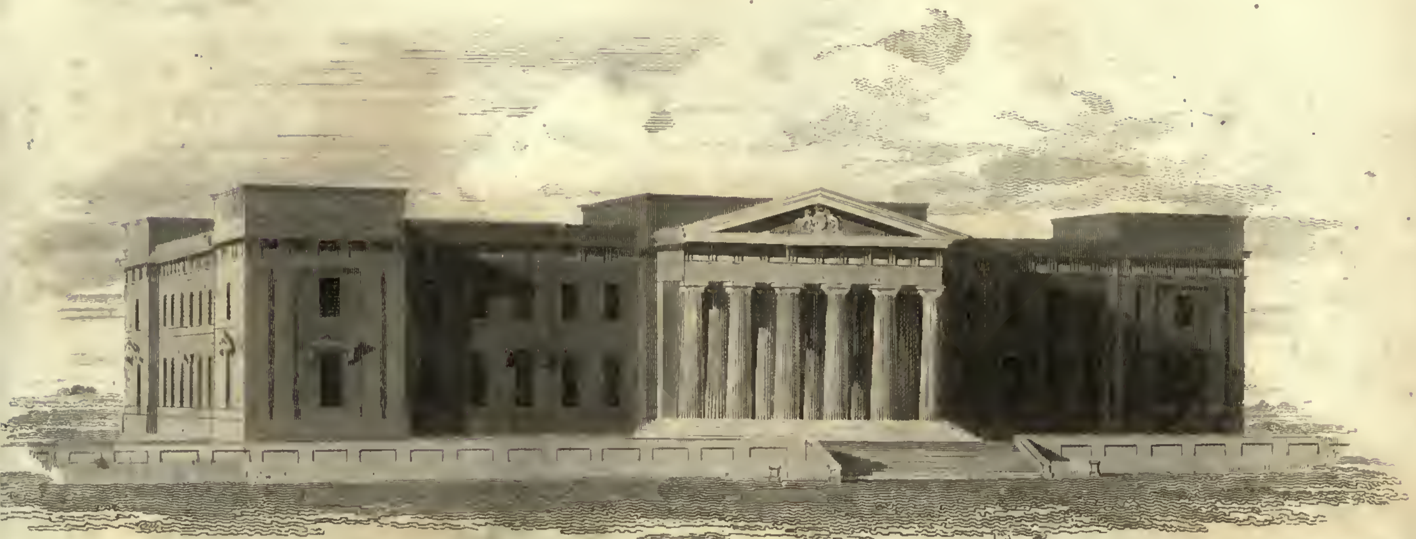


Fig.2.

PLAN ELEVATION AND SECTION OF St. GENEVIEVE PARIS.

Fig.3.

Fig.4.

Drawn & Engraved for the Encyclopaedia Edinensis by W.&D. Lizars Edinburgh.

NEW EPISCOPAL CHAPEL YORK PLACE EDINBURGH, DESIGNED BY ARCH^D. ELLIOT ESQ^R. ARCH^T.

Engraved for the Encyclopaedia Edinensis by W. & D. Lizars Edin^r.

INSIDE VIEW OF ROSLIN CHAPEL NEAR EDINBURGH.

RHEIMS CATHEDRAL.

Plates.

a stream of water was conducted to a clypsedra in the interior of the edifice to mark the time in the absence of the sun. The height is about 44 feet and the diameter about 26 feet.

Fig 2. The Parthenon at Athens, one of the finest specimens of ancient architecture, is peculiarly distinguished for its grandeur, simplicity, and sublimity. The length when entire was 217 feet, the breath 101 feet; the number of the columns 58, the height 34 feet, and the whole height of the order 45 feet. During the siege of Athens in 1687 by the Venetians, the Turks converted the Parthenon into a powder magazine; a bomb fell into it, kindled the powder, and blew it up. Eight columns of the east front, and some of the side porticos yet remain.

Fig. 3. The Choragic monument of Lysicrates, which is commonly called the Lantern of Demosthenes, stands near the east end of the Acropolis at Athens, is reckoned a fine specimen of ancient art, in the Corinthian order, and was erected about 330 years before the Christian era, and in the time of Alexander the Great, in commemoration of a musical entertainment exhibited by Lysicrates. It is of a circular form, about 8 feet in diameter, and 34 feet high; and is composed of a basement, colonnade, and cupola.

Fig. 4. Temple of Vesta at Tivoli, of which eleven out of eighteen columns of a circular colonnade remain, when it was described by Desgodetz. Great part of the wall, containing the door and one of the windows, was also entire. The columns are two feet four inches at the base, and they are channelled with 24 flutings. This beautiful fragment of ancient art stands opposite the cascade of the Teverone, and is five or six leagues from Rome.

Fig. 5. and 6. Plan and elevation of the Pantheon, now called the Rotunda, at Rome. The Pantheon, which was built by Agrippa, the son-in-law of Augustus, has been always regarded as one of the finest specimens of Roman architecture, and, fortunately, it is one of the most entire of the ancient edifices. It was dedicated, as the name imports, to all the gods. Pope Boniface IV. dedicated the Pantheon to God, by the name of the Blessed Virgin and the Holy Martyrs. In 1627, Pope Urban VIII. caused two columns of the portico, which had been removed, to be replaced, and the capitals which were wanting to be restored, the front to be repaired, and the rubbish cleared away around it, by which the two upper steps to the portico were discovered.

Plate 18. Fig. 1. A fine modern specimen of the Grecian Doric, in the Court-house, Public Offices, and Gaol of Glasgow, erected in 1810, at an expence of L.35,000, from the design of the late Mr William Stark, architect, whose pure, classical taste is abundantly conspicuous in other public edifices in the same place, as the Hunterian Museum and the Lunatic Asylum. This view is copied from an elegant original drawing by Mr Stark himself, for which we are indebted to the liberality of his relative Mr George Thomson, of the Trustees' Office, Edinburgh. In justice to the ingenious artist, it ought to be noticed, that the elevation of the building is less by several feet than was originally intended by Mr Stark; and this depressed appearance, which diminishes the grandeur of effect, is farther increased by the surrounding parapet-wall and railing, behind which the colossal steps, which form the ascent to the portico, are concealed. But this last addition was no part of Mr Stark's design.

Figs. 2. 3. and 4. Elevation, plan, and section of the Church of St Genevieve, at Paris, the design of which is taken from the Pantheon at Rome. The columns, which are of the Corinthian order, are $5\frac{1}{2}$ feet in diameter, and, including the base and capital, 58 feet high, French measure. At the commencement of the revolution, this edifice was destined, under the name of the French Pantheon, to receive the ashes of patriots and warriors; its ancient name was restored during the reign of Bonaparte, and the underground part of the building was limited to the same use. In the original design, Soufflot, the architect, proposed the dome to be surmounted by a lantern, for which a colossal statue of Fame, in bronze, is projected, and a model in plaster, of 25 feet in height, has been executed by Dejoux, the statuary; but it is feared that the dome is not fit to receive that additional weight.

Plate 19. View of the Episcopal Chapel, in York Place, Edinburgh, an example of modern Gothic, from a design of Mr Elliot, architect, who obligingly permitted us to copy his original drawing. The whole expence of this edifice, which accommodates 1000 persons, is estimated at L.12,000. The area which it occupies is 124 feet in length, and 73 feet in breadth. The height of the nave on the south side, to the top of the battlements, is $51\frac{1}{2}$ feet, and on the east and west fronts, to the top of the cross, 62 feet, and the height of the side aisles is $33\frac{1}{2}$ feet. The octagonal towers rise to the height of $81\frac{1}{2}$ feet. Including the altar, the length of the nave is 106 feet, the breadth 26 feet, and the height 35 feet. The altar window, which is to be decorated with stained glass, is 32 feet 8 inches from the sole to the top of the arch, and the breadth is 13 feet 6 inches. The ceiling of the nave, which is to be a flat Gothic arch, is to be enriched with Gothic fret-work; and the cielings of the side-aisles are to be decorated in a similar manner. The pulpit and fronts of the galleries are to be richly finished with oak in characteristic style, and the whole is to be completed in 1817.

The Chapel of Roslin, near Edinburgh, was erected in 1446, and exhibits a singular mixture of various styles. The view on Plate 19. shews the rich internal decorations of the edifice. Seven columns on each side, supporting pointed arches, divide the nave from the side aisles; and over them, in the middle aisle, which is highest, is a row of windows. The cieling, capitals, architraves, and key-stones, are covered with a profusion of sculpture work, representing foliage, flowers, scenes from sacred history, texts of scripture, intermixed with grotesque figures. The Apprentice's, or Prince's Pillar, as it is sometimes called, has been always admired for the richness of its ornaments, and the exquisite neatness of its sculpture. It is peculiarly distinguished by four spiral wreaths of flower-work and foliage, all different in design, and so finely executed as to resemble lace. The story of Abraham offering up Isaac is represented on the capital of this pillar.

Plate 20. represents the west front of the Cathe-

Plates.

dral at Rheims, which has been long the boast of France, and in the excellence of its proportions, and the richness and delicacy of its ornaments, is regarded as the most perfect specimen of Gothic architecture in existence. This cathedral was originally founded in the year 818; it was burnt in 1210; occupied 30 years in rebuilding, and was finished in 1241; but it is supposed that the grand façade represented on the plate, was not completed till towards the end of the 13th century. The magnificence of the portal, and its nice proportion to the rest of the edifice, form the chief excellence and beauty of the west front, and fully display its characteristic features.

INDEX.

Index.

ARCHITRAVE is a term in architecture, denoting the lowest member of the entablature, or that part of it which rests immediately on the column.

ARCHON, from the Greek, signifying to *command* or *order*, is an appellation which was applied to the chief magistrate of Athens. Every person who aspired to the office of archon was required to prove that his progenitors had been citizens of Athens for three generations; that he believed and practised the religion of his country; that he had been obedient to his parents; and that he had served in the army. The commissioners appointed to enquire into these points being satisfied, an oath was administered to the archons, by which they bound themselves to maintain the laws under the sanction of forfeiting a statue of gold of the weight of their own body, which was to be presented to the temple at Delphi.

The whole administration of the state was entrusted to the archons, who were nine in number. The first was properly denominated Archon, because he was the chief of the nine. All domestic matters came under his jurisdiction, such as disputes between married persons, parents, and children, all causes relating to dowries, wills, and legacies, and providing tutors and guardians for orphans. To the second archon, who was called king, was committed the power of judging in all matters connected with religion. It was the proper office of the third archon to provide for the children of those who had fallen in defence of the country, to appoint games to commemorate the patriotism and valour of those who were slain in battle, to offer sacrifice to Mars and Diana, and to watch over the concerns of strangers in Athens. The othes six archons, who were entitled guardians of the laws, possessed functions of a more varied and general nature. All matters of police, which were not assigned to the three principal archons, fell under their jurisdiction.

ARCHYTAS, a Pythagorean philosopher, and the contemporary of Plato, flourished about 400 years before the Christian era; and by his influence with Dionysius the tyrant of Sicily, it is said he saved the life of his master Plato. His talents and conduct raised him seven times to the command of the army, in opposition to a positive law which prohibited the same person from holding that high office oftener than once; and he was frequently chosen chief magistrate of Tarentum his native city. Archytas was greatly distinguished for his mathematical knowledge; he discovered the duplication of the cube by means of the conic sections, and the method of finding two mean proportionals between two given lines; and to him also is ascribed the invention of the screw, the crane, and some hydraulic machines. Aristotle, it is said, is indebted to this philosopher for his methodical arrangement or general distribution of knowledge, entitled, the "Ten Categories." His skill in astronomy and geography is finely commemorated by Horace, who laments his fate in having perished by shipwreck on the Apulian shore. A treatise of Archytas, "On the Universe," and some fragments on "Wisdom," and on "the Good and Happy Man," are yet extant.

ARCOT, the capital of the Carnatic, in Hindostan, is a city of considerable extent, stands on the banks of the Paliar, and is strongly defended; and has been frequently a disputed post between the British on the one hand, and the native princes and the French on the other, from the time it was taken by Colonel Clive in 1751, till it finally became a tributary territory of Great Britain. Arcot is 55 miles south-west from Madras, and 65 north-west from Pondicherry.

ARCTIC, from the Greek, signifying a *bear*, is a geographical term synonymous with *northern*, as, *arctic* pole, *arctic* circle, which is $23\frac{1}{2}$ degrees from the pole, and *arctic* regions, which are included within that circle.

ARCTIUM, Burdock, a genus of plants belonging to the Syngenesia class.

ARCTOPUS, a genus of plants belonging to the Polygamia class.

ARCTOTIS, a genus of plants belonging to the Sygenesia class.

ARCTURUS, from the Greek, signifying the *tail* of the *bear*, is a fixed star of the first magnitude, in the constellation Bootes, towards which the tail of the great bear approaches.

ARCUEIL, a small town of France, and about three miles south from Paris, is celebrated for the excellence of its water, which is conveyed to Paris by a stupendous subterraneous aquæduct, 7000 toises in length, and constructed of free stone. This splendid work was executed in 1624, under the auspices of Mary of Medicis.

Arcueil has more lately acquired notice by the establishment of a society in 1806, which meets every fortnight at the country house of Berthollet, for the purpose of investigating physical and chemical subjects. Memoirs are read, experiments are repeated, and reports on journals and works connected with the objects of their researches, are drawn up by the members among whom this labour is distributed, and presented to the consideration of the society. The most distinguished philosophers of France are associates of this institution; and the volumes of their memoirs, already before the public, afford a favourable specimen of the importance of their labours.

ARDEA, including the stork, crane, and heron, is a genus of birds belonging to the order Grallæ. See Ornithology.

ARDEBIL, an ancient and celebrated town of the province of Aderbijan in Persia, stands in a wide plain on the banks of the river Karasu, not far from the Caspian sea, and is enclosed by a mountainous amphitheatre. Ardebil was once a royal residence, and a place of strength, but is now destitute of walls; the great square is spacious, and the caravanseray for the accommodation of merchants is a large building. All kinds of European and Asiatic manufactures are exposed to sale in the market place; and a constant intercourse is kept up, by means of caravans, with Constantinople and Smyrna. The tomb of a scheik, a reputed saint, in one of the churches, is regarded as an inviolable asylum, and attracts numerous pilgrims from all parts of Persia. Various fruits, as apples, pears, and peaches, are abundant in the surrounding districts, and the more elevated grounds afford excellent pasture to numerous flocks of sheep. Mineral waters abound, and the public baths of the city are supplied from copious springs nearly at the boiling temperature.

ARDECHE, a department of France, formerly the province of Vivarais, bounded on the north by the department of the Rhone and Loire, is more than 60 miles long, and from 15 to 30 miles broad, is watered by the Rhone, the Loire, and the Ardeche, and produces grain, wines, honey, and silk. The population exceeds 267,000, and Privas is the chief town.

ARDENNES, a department of France, including the great forest from which it derives its name, is bounded on the north by the department of Jemappe, and on the south by the department of the Marne, is well watered by the rivers Meuse and Aisne; abounds in all kinds of grain; coal, slate, and iron, are among its mineral productions; the extent exceeds a million of acres; and the population exceeds 264,000. Mezieres, which occupies an island formed by the Meuse, is the chief town.

AREA, the superficial content of any figure. Thus a square surface of twelve inches on each side contains 144 square inches.

ARECA, the Cabbage-tree, a genus of plants belonging to the class of Palms. The *Areca oleracae*, a native of the West Indies, and other warm climates, grows to a great height, and affords a delicate vegetable for the table.

ARENA, the central space of the Roman amphitheatre, in which the combats were exhibited. It was thus denominated because it was covered with sand; and hence, too, the gladiators were called *arenarii.*

ARENARIA, or Sandwort, a genus of plants belonging to the Decandria class.

AREOPAGUS, from the Greek, signifying the *hill* or *rock of Mars*, a sovereign tribunal at Athens, the justice and impartiality of whose decrees had acquired so high a character, that the gods themselves, it is said, were submissive to its decisions. The name and origin of this celebrated court are lost in obscurity. Conjecture assigns its institution to Solon, the great Athenian legislator; some derive its name from the suburbs of Athens, in which the hill or rock of Mars stood; and others trace it to the court of justice in which the senate assembled. Some are of opinion that the court of Areopagus existed before the time of Solon, and ascribe to that celebrated lawgiver the merit of reforming, restoring, and extending its authority, by uniting the power of other tribunals under its jurisdiction.

A law of Solon limited the privilege of being a a member of the Areopagus to those who had faithfully served the office of archon; and hence, by an obvious mistake, it has been supposed that the original number of the Areopagites corresponded with that of the archons. The number of members composing the court of the Areopagus seems to have varied at different periods of its history, from thirty-one to fifty-one, and even to five hundred. The character of those who were to be elected to the office was subjected to the severest scrutiny; the appointment of the judges was for life, and the fixed salaries were extremely moderate.

The whole affairs connected with the system of public police, and all matters relative to religion, fell under the jurisdiction of the court of the Areopagus. Their assemblies were held in the night, that their decisions might not be influenced by any other objects than by the arguments of the speakers. The parties themselves originally pled their own cause; but when greater refinement was introduced, hired pleaders were employed. To preserve impartiality, even the order in which causes were to be heard was regulated by lot. The decisions of the judges were given in the manner of the modern ballot. Two urns were employed to receive small pieces of flint, with which each judge voted. One of the urns was called the *urn of death* or *condemnation*, and the other was denominated the *urn of compassion* or *acquital.*

The simple edifice which was originally appropriated to the assembly of the Areopagus, was decorated and embellished about the time of Augustus. Seats of solid silver for the accuser and the accused, were introduced; and an altar dedicated to Minerva, and a tomb to the memory of Oedipus, were also erected. But the progress of luxury tainted the institution of the Areopagus with the corruptions and vices of the times; the severity of its regulations and decisions relaxed; it lost its original purity; and had altogether ceased to exist in the fifth century. The apostle Paul was called before this tribunal to give an account of his doctrine, and by his arguments and eloquence converted Dionysius one of its members.

AREQUIBA, a city of Peru, in South America, built by Pizarro in 1539, occupies a delightful spot in the valley of Quilca, and on the banks of the river Chili, and is 20 miles from the sea and 180 miles distant from Cusco. The climate is dry, temperate, and salubrious. The population, before an earthquake in 1785, exceeded 30,000; wine, oil, and corn are imported from Spain; and cotton-cloths and cordage, with other naval stores, are brought from Chili and Mexico. The houses, which are of stone, are constructed with neatness and elegance; a splendid bronze fountain adorns the great square; and a fine bridge affords a commodious communication to both sides of the river.

ARETIN, Guido, a native of Arezzo in Tuscany, flourished in the 11th century, and is known chiefly for his improvement in musical notation. He assumed the monastic habit, and was appointed abbot of a convent near his native place. The performance of a Latin hymn, the verses of which begin with the syllables, *ut*, *re*, *mi*, *fa*, *sol*, *la*, and the frequent repetition of the same sounds suggested the hint of adopting them in musical notation; the improvement was introduced; and the new discovery was considered of great importance in facilitating the method of learning the practice of the art. To the same author is ascribed the method of writing music on lines and spaces. Before his time a single line only was used, and the different notes were distinguished by the letters of the alphabet. Guido employed four lines with the intermediate spaces, after which another line was added, which completes the present system.

AREZZO, the ancient Aretium, a city of Tuscany in Italy, occupies the declivity of a hill which rises in the middle of a fertile plain, abounding in grain, wine, and oil, was a place of some trade in the time of the Romans, and was the birth place of Mæcenas, the great patron of literature in the Augustan age of Rome, and of the celebrated poet Petrarch.

ARGEMONE, Prickly Poppy, a genus of plants belonging to the Polyandria class.

ARGENTAN, a town in the department of Orne in France, stands on an eminence on the banks of the river Orne, contains a population exceeding 5000, and has some manufactures of lace and linen cloth, of light stuffs, and white leather.

ARGENTIERE, an island in the Grecian Archipelago, and the ancient *Cimolia*, from the earth so called, which is employed for washing, is about 18 miles in circumference, presents a sterile aspect of rocks, destitute of verdure, diversified with vallies, in which some vegetation appears, and produces some wheat, barley, and cotton. The only domestic animals that are reared in the island are hogs and poultry. The population is variously stated from 200 to 500; the women, remarkable for a stiff fantastic dress, are employed in knitting cotton stockings; and the men are engaged as fishermen and pilots. The calcined aspect of the rocks, the abundance of puzzolana, and the hot springs, are regarded by travellers as certain indications of volcanic action.

ARGENTON, a fine town in the department of Indre in France, occupies a delightful spot on the banks of the river Creuse, which flows through a fertile valley clothed with vineyards. The population exceeds 3000, and the manufacture of flint glass has been long successfully conducted.

ARGONAUTA, or Paper Nautilus, a genus of univalve shells, of which the most remarkable is the Argo, containing a singular animal, which has the power of raising itself to the surface of the ocean, and, with the aid of an apparatus resembling sails and oars, glides along the liquid element. To the movements of this animal the noble art of navigation has been fancifully traced. See Conchology.

ARGONAUTS, were illustrious Greeks, who according to the mythological history, embarked with Jason in the ship Argo from Colchis, to obtain possession of the golden fleece. Phryxus and Helle the son and daughter of Athamas, king of Thebes, to avoid the ill treatment of their stepmother, Ino, the daughter of Cadmus, went on board a ship which had a golden ram for an ensign, and sailed to Colchis. Helle was drowned during the voyage, in the strait which was called the *Hellespont*, or sea of Helle, now the Dardanelles. This is the account of the expedition as it is recorded by Greek writers. But the fabulous history represents Nephele, their divorced mother, bringing them a ram with a fleece of gold, and desiring them to mount on its back and direct their course to Colchis. With a rapid flight they were carried through the air, but Helle became giddy and fell into the Hellespont. Her brother arrived in safety at Colchis, offered the ram in sacrifice to Mars, and hung up the golden fleece in the temple of that divinity. Bulls breathing fire, and a dragon which never slept, guarded the fleece, to recover which was the object of the famous expedition undertaken by Jason and his companions.

The origin of this fable is ascribed by some to the method of collecting gold, which was washed down by torrents in the mountains of Colchis. Woollen fleeces were stretched across the stream to retain the particles, and the expedition was fitted out by the Greeks to procure that precious metal. According to Sir Isaac Newton, the Argonautic expedition took place about 30 years before the fall of Troy, and was an embassy sent by the Greeks to the nations along the Euxine and Mediterranean seas, to throw off the yoke of the sovereigns of Egypt, and the expedition of the golden fleece was merely a pretext to cover their real design. Dr Gillies, the historian of Greece, regards the fonndation of this celebrated expedition as a confederacy formed by the Grecian states, under the direction of the famous council, for the purpose of conquest and plunder; and supposes that the designs of the Argonauts were veiled under the allegorical expression *of carrying off the golden fleece*. Mr Bryant rejects the history of the Argonautic expedition as a Grecian fable, and refers the whole to traditionary stories connected with the deluge, and the preservation of Noah and his family in the ark.

ARGOPHYLLUM, White-leaf, a genus of plants belonging to the class Pentandria.

ARGOS, now ARGO, the ancient capital of Argolis, a district of Peloponnesus, was celebrated for the number and magnificence of its public edifices, of which few traces now remain; but it is still a place of considerable extent. An elegant mosque, rising from the shades of solemn cypress, presents a striking contrast to the whitened mud-built houses.

ARGUIM, or ARGUIN, an island on the western coast of Africa, is about 16 miles distant from Cape Blanco, and not more than two miles in length; but has been the scene of many hard struggles among different nations for its possession. It was discovered by the Portuguese in the 15th century, and the English, French, Dutch, and Portuguese became alternately masters of it during a period of more than 200 years. It seems to have been considered a convenient station for the gum trade; but it was probably from national jealousy and rivalship that its occupancy was so long and so expensively disputed.

ARGUS, according to ancient mythology, was the son of Aristor, and had a hundred eyes, fifty of which were always open. Argus was appointed by Juno to guard Io; but Jupiter sent Mercury, who by the powers of his flute charmed him to sleep, sealed up his eyes, and cut off his head. In reward for his faithful services, Juno transformed him into a peacock, whose tail has ever since exhibited a representation of his numerous eyes. This fable is the origin of the expression *Argus-eyed*, applied to those who are distinguished by vigilance and circumspection.

ARGYLESHIRE, an extensive county of Scotland, having the Atlantic ocean and the Irish sea on the west and south, the Frith of Clyde, Dumbarton, and Perthshires on the east, and Inverness-shire on the north, is about 115 miles long and about 70 miles broad, is intersected by numerous arms of the sea, and comprehends a number of the islands which come under the general denomination of the Hebrides. Exclusive of the islands, of which Islay, Jura, and Mull are the chief, included in this county, the main-land of Argyleshire presents great variety of picturesque and romantic scenery. Some of the mountains rise to an elevation of 3000 feet; the rivers, from their short course, are to be regarded only as mountain torrents; and Loch Awe is a beautiful expanse of water, 30 miles in length, and two and three in breadth. Ardnamurchan and Morven, towards the north, are peninsular districts, formed by arms of the sea stretching far inland; and Kintyre, the termination of which is at the Mull, or headland, projecting into the Irish sea, is united at Tarbet by a narrow neck of land. The Linnhe loch, which is to form part of the track of the Caledonian canal, traverses Argyleshire from north-east to south-west. The Crinan canal was planned and executed for the purpose of avoiding the circuitous and sometimes dangerous navigation round the Mull of Kintyre. It is about three miles long from Loch Gilp on the east to Loch Crinan on the west.

Mineralogy.—Argyleshire presents a wide and varied field for mineralogical research. Every kind of rock, whether of the primary or secondary class, is found within its limits. The Nuns islands, off the west coast of Mull, are composed of a beautiful red granite; gneiss is the repository of the lead-mines at Strontian; micaceous schistus forms a large proportion of the rocks in Islay and Jura; and the argillaceous schistus of Eisdale, Ballychelish, and other places on the western coast, furnish great quantities of excellent roof slate. The anomalous position of granular quartz, which occupies the place of granite in Islay and Jura, seems to subvert the venerated authority of certain modern geological systems. Syenite is abundant in some parts of Islay; and the beautiful porphyry of the same island is not inferior to the celebrated green porphyry of Egypt. Potstone, or Inveraray marble, as it is sometimes called, is dug out of a quarry at St Catharine's, on the banks of Loch Fine, which furnished the stone for the castellated mansion of the Duke of Argyle. The strata of limestone, both primitive and secondary, are extensive; examples of basaltic rocks, in a columnar, amorphous, or vertical form, are numerous, as in Mull, Staffa, and the neighbouring islands; and coal has been wrought for many years near Campbelltown; Great masses of breccia, or plumb-pudding rock, are deposited round Oban and other places; bog-iron ore covers tracts of considerable extent; and lead-ore has been long dug out in Islay and at Strontian.

Antiquities.—Numerous remains of ancient castles, the residence of powerful barons, yet exist in the main-land and islands of Argyleshire. The mouldering ruins of a seat of the chief of the Macdonalds, whose power enabled him to assume independent sovereignty, are yet visible in Islay; Castle-Dowart, on a projecting cliff in Mull, was the chief residence of the Macleans; and Dunstaffnage, near Oban, can boast of having been a royal residence.

Population, Towns, &c.—The population of Argyleshire, which in 1801 was not less than 78,000, had increased in 1811 to 85,585. It is divided into 49 parishes. Inveraray, Campbelltown, Oban, and Bowmore in Islay, are the chief towns. Many of the proprietors occupy elegant modern mansions; and Inveraray Castle, one of the residences of the Duke of Argyle, is also a modern edifice.

Husbandry, &c.—The chief cultivated crops of Argyleshire are oats, barley, and potatoes. Many of the recent improvements in agriculture have been successfully adopted by spirited individuals. The breed of cattle has greatly improved and extended, and is a very considerable source of revenue both to the islands and main-land; the dairy husbandry is pursued in some of the arable districts, and the mountainous pastures rear a numerous and hardy race of sheep. The real rent of the county in 1811 was about L.192,000.

Fisheries, Manufactures.—The great extent of coast, and the numerous bays and arms of the sea included in this county, afford great facilities for the fisheries, in which a large proportion of the inhabitants is profitably employed. Loch Fine has been long celebrated as a station for the herring fishery, which in the years 1794 and 1795 yielded a return of more than L.80,000. The manufactures are almost limited to those of a domestic nature. The manufactory of woollen established at Inveraray has not flourished, and attempts to introduce the manufacture of cotton have also failed. Iron is smelted at two places in the county, and tanning and ship-building are carried on at Campbelltown and Oban.

ARIADNE was the daughter of Minos, king of Crete, and, according to the mythological history, became enamoured of Theseus, who was sent to destroy the minotaur. Theseus having performed his task, and escaped from the labyrinth by means of a clue of thread with which she furnished him, married her, conducted her to Naxos, along with the Athenians whom he had relieved, and afterwards abandoned her. The fountain of Ariadne, in the isle of Naxos, is still an object of curiosity to the traveller.

ARIANO, a town of the farther principality of Naples, stands on the summit of a mountain, includes a population of 1400, has no trade or manufactures, and is subject to frequent earthquakes, one of which, in 1456, shook it to its foundations. It has never recovered from this disastrous calamity. The convent of Dominicans, in the vicinity of the town, has been three times thrown down, and as often rebuilt, within the period of a century. The most destructive shock which befel it happened in 1732, and spread devastation along the whole eastern range of the Appennines. The vine is cultivated in the surrounding country, and yields a pale sharp wine.

ARIANS, a religious sect, which derived its name from Arius, a presbyter of the church of Alexandria, who lived in the early part of the fourth century, and maintained that Jesus Christ was totally and essentially distinct from the Father; that he was the first of those beings whom God had created, and the instrument by whose subordinate operation all things were made, and therefore inferior to the Father in nature and dignity. The doctrine of Arius was condemned by the council of Nice which assembled in 325, the author himself was banished, and his books were ordered to be burnt. Recalled at the end of five years by the emperor, he drew up a confession of his faith, which proved satisfactory to the government, but Athanasius, bishop of Alexandria, refused to admit him and his followers to communion. The banishment of Athanasius was the consequence of this refusal. His successor in the church was equally obstinate; the peremptory order of the emperor was interposed, but before it was complied with Arius died, not without suspicion of having been poisoned.

For several centuries Arianism was either countenanced by the government, or suppressed by the civil power, as the influence of its professors or their opponents prevailed at the imperial court. Ancient writers, according to certain modifications of the doctrine, describe three classes of Arians, the *genuine Arians*, the *semi-Arians*, and the *Eunomians*. This doctrine continued to spread in different countries; it was supposed to be nearly extinct for some hundreds of years, when, as was alleged, it was restored by Erasmus, in his Commentaries on the New Testament; about the beginning of the sixteenth century it was encouraged and supported in Geneva, and afterwards in Poland; and in the beginning of the eighteenth century Mr Whiston, a divine of the church of England, and professor of mathematics in Cambridge, was deprived of the pastoral office, and of his professorship, for embracing Arianism. Dr Samuel Clarke adopted somewhat similar sentiments, and a keen and protracted controversy commenced, and was conducted with great ability on both sides. See *Mosheim's Church History*, and Collection of Pamphlets on the controversy concerning the Trinity, from 1712 to 1719, London, 1720, and Lardner's Credibility, vol. ix.

ARICA, a sea-port town of Peru, in South America, which has been often visited with severe earthquakes, is chiefly inhabited by Indians, blacks, and mulattoes; most of the houses are constructed of reeds or canes; has a little trade with some of the other towns on the coast; and in the valley, which stretches eastward into the country, cotton and pimento are cultivated. Rock-salt, dug from the contiguous mountains, is enumerated among the exports from Arica.

ARIES, the ram. See Ovis under MAMMALIA.

ARIES, one of the northern constellations, and the first of the twelve signs of the zodiac.

ARILLUS, the external covering of the seeds of plants, which is sufficiently conspicuous in the garden bean, the seeds of the cucumber, and still more obvions in coffee, as it includes two seeds or beans.

ARIMANIUS, the evil demon in the religious system of the ancient Persians. The Magi believed in the existence of two great powers in nature, the one the author of all good, and the other the author of all evil. Oromasdes, the name of the benevolent superintending power, dwelt in the purest light, formed man susceptible of virtue, and furnished him with the means of happiness, directed the revolution of the planets, controuled the elements, and preserved the order of the seasons; and for the accomplishment of his benevolent purposes, he created various subordinate deities. The abode of Arimanius, or the evil demon, was in the deepest darkness; he created a number of evil beings, to counteract, by their malignant influence, the good designs of Oromasdes, and to disturb the harmony both of the natural and moral world. But certain limits are set to his power, which in the end must yield to Oromasdes, when all evil shall be banished from the universe. The doctrine held by Zoroaster supposes that both these powers are subordinate to the first author of all things.

ARIMATHEA, the modern RAMLA, a town in Palestine, not far distant from Lydda, presents numerous remains of its former magnificence, but has now dwindled to a small place, with scarcely 1000 inhabitants, who are employed in the manfacture of soap and cotton.

ARION, a celebrated ancient musician and poet, was a native of Lesbos, and flourished about 600 years before the Christian era. He resided some time at the court of Periander king of Corinth, travelled into Italy, amassed great wealth, for the sake of which the sailors of the vessel in which he returned to Greece threw him into the sea; but a dolphin, which had been charmed by his melodious strains, took him on its back, and conveyed him safely on shore. Having escaped from a watery grave, he repaired to Corinth, and the king ordered the barbarity of the seamen to be punished by death.

ARIOSTO, Ludovico, a celebrated Italian poet, was a native of Reggio in Lombardy, where he was born in 1474; and his family, originally from Bologna, claimed alliance with the dukes of Ferrara; but could not boast of affluence equal to their illustrious descent. Destined by his father to the profession of the law, he spent five years at Padua, in the preliminary studies; but the pleasures of poetry allured him from the less attractive pursuits of legal disquisitions, and on the death of his father made him entirely abandon the preparatory steps for an employment which was little suited to the strong bias of his mind. His earliest years furnished ample proof of poetical genius in a dramatic composition, which he had wrought up from the beautiful story of Pyramus and Thisbe, in Ovid, and which was represented by the juvenile part of his father's family. When he relinquished the study of the law, he had acquired great facility in the composition of Latin poetry; he had been extremely assiduous in improving his own language; had cultivated Italian poetry; and even, it is supposed, had made some progress in his most celebrated production, the *Orlando Furioso*.

According to the fashion of the times, when princes encouraged the residence of men of literary distinction near their persons, that they might enjoy the reflected honour of their talents and reputation, Ariosto was admitted, in his 29th year, to the court of Hippolito, cardinal of Este, which was then the resort of some of the most learned men of the age; he was afterwards employed by the Duke of Ferrara in a diplomatic character, on a mission to the Roman pontiff; and when Leo X. his former friend, was raised to the pontificate, he revisited the ecclesiastical metropolis, in the expectation of improving his fortune, and obtaining the patronage of that distinguished pontiff. But the grant of a bull, securing to him the profits of his literary works, and the smiles of a gracious reception, were all the favours which he received from his holiness. Disappointment hastened his departure from the Vatican, and the festal scenes which were then exhibiting at Florence, drew him to that city, from which, after a residence of six months, he returned to the court of the cardinal of Este, resumed the composition of the Orlando Furioso, and, in 1515, published it at Ferrara, with a dedication to the cardinal, in a lofty strain of fulsome panegyric. But this flattery produced no applause from his patron, who reproved him for a misapplication of his time and talents in such a composition. Some time afterwards, Ariosto having declined an invitation to attend the cardinal in a journey to Hungary, his monthly salary was withdrawn, and he retired to a small house of his own in the vicinity of his native place. After the death of the cardinal he was invited by the duke of Ferrara to his court, and the liberality and beneficence of that prince enabled him to fix his residence in an agreeable situation in Ferrara, where he spent the remainder of his days, and composed great part of his works. He died in June 1533, in the 59th year of his age, and was interred in the church of St Benedict, without any memorial to mark the spot where his ashes reposed. After the lapse of forty years, a tomb, to which the bones of Ariosto were removed, was erected in one of the chapels of the church, by his friend Agostino Mosti, and on the tomb his statue was placed with a Latin inscription; and a great grandson of the poet, resolved not to be outdone by strangers, raised, in another chapel, a splendid marble monument with an alabaster statue.

Ariosto was the author of several other poetical compositions beside the Orlando Furioso, which has transmitted his name to posterity. The plan and many of the incidents of this poetical romance, are derived from the *Orlando Inamorato* of Boyardo, a poem of a similar character. The Orlando Furioso has been charged with being defective in unity of design; the plot is intricate and perplexed, and the train of events is broken and interrupted; but it is distinguished by remarkable fertility of invention, splendid imagery, and vigorous expression. But these striking beauties are not considered as sufficient to compensate for its faults, or to have its claim allowed before the tribunal of criticism to be ranked among the legitimate productions of the epic muse. The English reader has an opportunity of judging of its merits in *Hoole's Translation*.

ARISTÆUS was the son of Apollo and Cyrene, according to ancient mythology, and is said to have communicated to mankind some of the arts of husbandry and rural affairs; such as the cultivation of the olive, the curdling of milk, and the management of bees, and for these beneficial discoveries he was placed among the stars. The classical reader will find his name mentioned in the 4th Georgic of Virgil.

ARISTARCHUS, an eminent Greek philosopher, was a native of the island Samos, and flourished about 280 years before the Christian era. The studies of Aristarchus were particularly directed to astronomy. He revived the opinion of Pythagoras relative to the motion of the earth, for which it is said he incurred the charge of impiety. But his beautiful discovery is the method of finding the distance between the earth and sun; a problem which had long and unsuccessfully occupied the ingenuity of philosophers. When the dark and luminous parts of the face of the moon are equal, and separated by a straight line, he perceived that a line, drawn from the centers of the sun and moon, is at right angles to a line joining the centers of the earth and moon; and the centers of the earth and sun being joined by another line, a triangle is formed, the longest of whose sides denotes the distance of the earth from the sun, and the shortest represents the distance of the earth from the moon. The principle of the problem is correct, and its solution depends on accuracy of observation; for by measuring an arch of the heavens intercepted between the sun and moon, all the angles of the triangle are determined, and, consequently, the distance of the sun from the earth may be discovered in terms of the distance of the earth from the moon. Proceeding in this way, Aristarchus ascertained the distance of the sun from the earth to be about 18 or 20 times greater than the distance of the moon from the earth, or equal to 4,800,000 miles, which falls greatly short of the more accurate results of succeeding observers. But the error is properly laid to the account of the imperfection of the instruments with which the angles of the triangle were determined, rather than to any defect in the method itself. The invention of a sun-dial is also ascribed to Aristarchus. His *Treatise on the Magnitude and the Distance of the Sun and Moon*, was published at Oxford in 1687.

ARISTEA, a genus of plants belonging to the Triandria class.

ARISTIDA, Oat-Grass, a genus of plants belonging to the Triandria class.

ARISTIDES, a distinguished statesman and warrior of Greece, flourished at Athens about 500 years before the Christian era, and, from his noble patriotism and inflexible virtue, was honoured by his countrymen with the distinctive appellation of the Just. The life of Aristides seems to have exhibited a constant struggle with Themistocles, another powerful citizen, and also a warrior and statesmen; and as the influence of the rival citizens prevailed, and the public measures which they proposed were approved or rejected, the tribute of applause, or the vote of censure or condemnation was pronounced by the Athenians. The agitation excited in the state by these rival candidates for popularity, is said to have forced an acknowledgment from Aristides, that the affairs of the Athenians would never prosper till they were both thrown into a dungeon, or till their interference altogether ceased.

But whatever were the private animosities of Aristides, he was always foremost when the impending dangers of his country required his talents and services. His conduct and courage were highly conspicuous at the famous battle of Marathon, which was fought 490 years before the Christian era; soon after he was raised to the high rank of chief magistrate; by the influence of Themistocles, who preferred an accusation against him, he was banished from Athens; was recalled from exile on the threatened invasion of Greece by the Persians under Xerxes; displayed his usual skill and bravery at the famous naval engagement of Salamis; and his sagacity and prudence were not less remarkable in allaying the petty feuds which the rival interests of the different states of Greece excited and inflamed. But the distinguished stations which he held, and the eminent services which he performed to his country, left him only in possession of the gratifying honours of a patriot. Far advanced in age, he died about 467 years before the Christian era; the expence of his funeral was discharged by the public; his daughters were portioned from the treasury, and a pension and an estate were bestowed on his son.

ARISTIPPUS, an ancient philosopher, and the founder of the Cyrenaic school, which derives its name from Cyrene in Africa, the place of his nativity. The high reputation of Socrates drew him to Athens; but the pleasures of sense occupied a larger share of his attention than the pursuits of philosophy, and the wealth which he possessed furnished the means of unrestrained indulgence in all kinds of licentiousness and dissipation. But even these means were exhausted; and he was the first of the disciples of Socrates who derived any pecuniary emolument for public teaching. Driven from Athens by his dissolute manners, he visited Corinth; was shipwrecked in a voyage on the island of Rhodes; resided for some time at the magnificent and luxurious court of Dionysius, the tyrant of Sicily; and on his return to Cyrene, died at Lipara, one of the Æolian islands.

The philosophy of Aristippus corresponded partly with the doctrines of his master Socrates. He rejected the mode of instruction which was then pursued, and held logic to be quite sufficient to teach truth and to fix its bounds. Pleasure and pain, he maintained, were the motives which determined the actions of men; the former produces the softer emotions, and the latter excites the more violent passions. True happiness, he asserted, consists in the assemblage of pleasure, and the enjoyment of the present moment is the best way to attain it. Aristippus was the author of a history of Libya; dialogues; books on luxury; and some epistles.

ARISTOCRACY, from the Greek, signifying *chief* and *power*, is a form of government by which the supreme power is intrusted to the chief persons of a state, or the nobles.

ARISTOLOCHIA, Birth-Wort, a genus of plants belonging to the Gynandria class.

ARISTOPHANES, a celebrated Greek comic poet, who flourished in the time of Pericles, under whom the Athenians attained the highest degree of prosperity, and enjoyed the greatest importance among the states of Greece, and was cotemporary with Plato, Socrates, and Euripides. Of the private life of Aristophanes, little is known; and of the precise period of his birth or death no record is preserved.

Fifty dramatic productions are said to have been the offspring of the prolific muse of Aristophanes; but eleven only in a perfect state have survived the wrecks of time; and they must be always regarded as precious relics of antiquity, exhibiting a lively picture of the manners of the age, and a correct view of the structure and arrangement of the early Greek comedy. The unrestrained licentiousness which prevailed in dramatic writing when Aristophanes lived, exempted no character, however distinguished or respected by rank and virtue, from the most direct personal satire. The legislature interfered to check the growing evil, and enacted, that no individual should be exhibited on the stage by name. The effect of this regulation gave birth to the *middle* comedy of the Greeks, in which characters could only be introduced under fictitious names and marked allusions; but the indulgence was still abused, and demanded another prohibition, which was followed by the *new* comedy, in which the general follies of mankind are satirized by more delicacy of wit and more refinement of humour. Of the dramatic compositions of Aristophanes, ten are to be ranked with the *old* comedy; his *Plutus* is the only play which comes under the improved character of the *middle* comedy.

Numerous translations of the comedies of Aristophanes have appeared in different languages. But the *Plutus* and the *Clouds* seem to have been most frequently the subject of translation and critical discussion. A French version was executed by the celebrated Madame Dacier; and, by the labours of Mr Theobald, the English reader can peruse the same comedies in his own language; and he will find an excellent translation of the *Clouds*, in the *Observer*, by Mr Cumberland. In the same work an elaborate attempt is made to vindicate the Greek poet from the charge of having contributed to the condemnation of Socrates, by exposing his character in a ludicrous and unseemly manner on the stage.

ARISTOTELIA, a genus of plants belonging to the Dodecandria class.

ARISTOTLE, one of the most illustrious of the Greek philosophers, and founder of the Peripatetic sect, was born at Stagira, a city of Thrace, about 382 years before the Christian era. His father, Nicomachus, was the physician and friend of Amyntas, king of Macedon, and derived descent, as did also his mother, from Æsculapius, whose skill in the art of healing, displayed during the Argonautic expedition, had elevated him among the gods of antiquity.

At the age of 17, he repaired to Athens, induced apparently by his love of learning, of which it was the seat, and an anxiety to attend the lectures of the eloquent but mystical Plato, at that period its brightest ornament. His industry, acuteness, and capacity of intellect, soon obtained the admiration of that generous teacher, who had the good sense and the liberality not to demand any sacrifice of opinion from the student beyond the claims of satisfactory evidence, and to whom, it is no wonder, that the independent but grateful mind of Aristotle ever afterwards manifested the most amiable reverence and affection. Of the continuance and amount of this commendable respect, we have strong proofs, in spite of some malicious misrepresentations, in the verses which he wrote after the death of Plato, and the erection of altars in honour of his memory, though the appointment of his nephew Speusippus, as successor in the academy, a man of little talent and less virtue, might naturally enough have excited resentment, had there been any tendency to it, or at least have stifled the expression of regard, if not energetically springing from the sincerest conviction. It is quite conceivable, that an avowed difference of sentiment on certain abstract questions, had already originated a *new* school, and that consequently Plato could not with propriety consider Aristotle as the most suitable, though he might be the ablest person, to take the lead of his disciples.

Twenty years tuition, under this skilful and erudite man, furnished Aristotle with all the science and literature of his age, and qualified him for that singularly interesting office, which he discharged with so much glory—preceptor to the son of Philip of Macedon. Before engaging in this important charge, to which he was invited by a flattering letter from that sagacious monarch, with whom he preserved a hereditary friendship, Aristotle had married Pythias, the niece and adopted heiress of one of his old school-fellows, Hermias, the aspiring and unfortunate sovereign of Assus and Atarneus. This lady narrowly escaped the calamitous fate of her uncle, who fell a prey to the treachery of the ungrateful Mentor, by flying with Aristotle, to whom she was betrothed, from Atarneus to Mitylene, in the isle of Lesbos. Here she soon afterwards died, leaving Aristotle a daughter of the same name, who rewarded his conjugal and paternal virtues by the most affectionate tenderness and devotion.

Alexander was in his fourteenth year when our philosopher, scarcely recovered from the affliction, and now rather more than forty, commenced the superintendance of his education. For about eight years, in which this was continued, with characteristic enthusiasm on one side, and the highest excellencies of maturer judgment on the other, Aristotle augmented his consequence in the court of Philip by the advantages of his political counsel, and extended his fame among the Greeks in general, as well by friendly and successful interference in their behalf, as by the splendid fruits of his genius. Nor was he less fortunate with those who were immediately concerned in his peculiar responsibility. The honourable distinctions which Philip and his queen Olympias conferred on him, and the unequivocal demonstrations of Alexander's respect, were not more agreeable to his feelings than creditable to their own discernment and gratitude. What man could do, perhaps Aristotle really did—qualify but not subdue an ardour of mind, which already shadowed out the gigantic features of his future renown, and a spirit of enterprise which even the conquest of the world failed to exhaust. It is among the most striking proofs of Aristotle's superiority of character, that he was, it is believed, the only one of the hero's early acquaintances whom he continued to regard with undiminished attachment through all the seducing fortunes of his eventful career. This distinction, it is certain, was not purchased by mean compliances, or the neglect of painful, though necessary admonitions. The philosopher did not soften down the rigour of salutary principles in courtly subservience to any vicious inclinations; though it be equally true, that some of the rougher lineaments of the pupil scarcely lost any of their prominence under the corrective precepts of his authority and wisdom.

On the death of Philip, and the departure of Alexander for Asia, in prosecution of his ambitious designs, the philosopher, either averse to the expedition, or unfit, from his constitutional infirmities, for the difficulties with which it seemed pregnant, returned to Athens, where, indignant, as it has been said, at the pretensions or success of the slow-paced Xenocrates, the head of the academy, but more probably from zeal in the cause of learning, he commenced public teacher. Students soon flocked to him from all quarters. His lectures were delivered in the Lyceum, a place allotted by Pericles for military exercises, but the amenity and quietness of which peculiarly fitted it for a school of learning. The instructions of the philosopher were usually communicated while *walking* in the delightful shades of this retreat, and hence Aristotle obtained the title of Peripatetic, which descended to his disciples.

During the life of Alexander, whose confidence he preserved, and who liberally assisted him with materials for the improvement of science, Aristotle found it easy to defeat the insidious devices with which jealousy of his doctrines, or envy of his reputation, assailed him, under the garb of reverence for religion; but on the death of that prince, his enemies acquired such influence as to become daring in their opposition, and render his life both uncomfortable and insecure. He prepared a defence against their illiberal and unjust accusations; considering, however, the weakness of the best cause, when withstood by prejudice and malignity combined, as manifest in the fate of Socrates, he thought it more expedient to seek safety in flight than to trust to the armour of reason, being unwilling, as he jocosely observed, to give the Athenians another opportunity "of sinning against philosophy." His death, hurried, it is probable, by such unmerited treatment, happened about a twelvemonth after, in the place of his retreat, Chalcis, in Eubœa, when he was sixty-three years of age, and after having taught in the Lyceum twelve years. Herpylis, a second wife, Nicomachus, a son by her, and his daughter Pythias, bemoaned his loss. Theophrastus, to whom he bequeathed a valuable collection of books, and his own writings, which were very numerous, succeeded to the Lyceum. Aristotle's bodily appearance was a foil to his mental worth. He was short of stature; his limbs were out of proportion, slender and feeble; he had a kind of impediment in his speech, and his eyes were unusually small. It was sometimes imputed to him by the malicious and the ignorant, that he bestowed more care in decorating his person than it deserved, or than altogether became a philosopher; but the good sense of Aristotle justly appreciated the favourable impression of neatness in dress, and despised the silly affectation of indifference and carelessness.

The fate of Aristotle's works was somewhat singular. Few were published in his lifetime. The remainder, which had been committed to Theophrastus, passed, on his death, to Neleus, who consigned them again to his heirs, men ignorant of their value, and though anxious, yet injudicious in their preservation, depositing them in a vault under ground, where they remained unregarded and impairing for some generations. They were then sold to Apellicon of Athens, who expended much, but inadequate labour, on the execution of a legible and useful copy, which was seized on, as well as the whole library of the restorer, by Sylla, the conqueror of Athens, and transmitted to Rome. Tyrannion having procured the manuscript from Sylla's librarian, communicated it to Andronicus of Rhodes, a philosopher resident at Rome in the time of Cicero. By this man the task of arrangement and correction was skilfully accomplished, and henceforth copies, of various excellence indeed, multiplied throughout the Roman empire. The works being of different kinds and value, were not all equally regarded; and in consequence, besides the influence of many other causes, both common and particular, out of more than 400 treatises which Aristotle is said to have composed, not quite fifty survived the invention of printing. Those which embrace a wide sphere of important subjects, obscure as they were, from a sententious brevity peculiar to this profound thinker, and rendered often much more so by the mistakes and affected learning of his myriads of transcribers, translators, and commentators, were long appealed to as the standard of truth, from which all deviations partook of a danger little short of religious heresy. Lord Bacon broke in upon this ill-placed veneration, and summoned Aristotle himself to the bar of nature. The result has been a conviction of immense errors, but, at the same time, the establishment of a character for extent, variety, acuteness, and ingenuity of research, fertility of invention, and a general display of well organised judgment, which has perhaps never yet been surpassed by any individual since the mysteries of the world awakened genius in the breast of mankind. His treatises on *Rhetoric* and *Poetry* alone would immortalise his name; his *Ethics* and *Politics* abound in valuable observations; his *Logic* is ingenious, refined, and subtle, well calculated to exercise the faculties, though incapable of promoting science; his History of Animals exhibits most commendable diligence, and is precious as having both invited and facilitated the study of natural history. "The whole of his remains together, (says Dr Gillies, one of his most sensible annotators,) still form a golden stream of Greek erudition, exceeding four times the collective bulk of the Iliad and Odyssey."

ARITHMETIC is that science which investigates the properties of numbers; or, in its application to practical purposes, it is the art of calculation by means of numbers. See MATHEMATICS.

ARIUS, a divine of the 4th century, from whose peculiar doctrines the sect of the Arians derived their origin. See ARIANS.

ARK of NOAH, a large vessel which was constructed by the patriarch Noah, for the preservation of his family and the different species of living creatures during the universal deluge. Great diversity of opinion has prevailed among writers on this subject concerning the materials, form, capacity, time, and place of the construction of the ark. According to the Scripture account, the ark was built of *gopher* wood, and covered with pitch or some bituminous matter. The gopher is variously supposed to mean *cedar*, *cypress*, or *pine*, which, from their resinous nature, are less subject than other woods to rot or decay. The *form* of the ark was an oblong square, the roof sloping and the bottom flat. As its object was to float on the waters of the deluge, no mention is made of any apparatus fitted for the purpose of impelling or guiding it. Three separate stories have been assigned to the ark; the lowest for the beasts, the middle for food, and the uppermost for the family of Noah and the feathered tribes; the whole is divided by some into 72 apartments, while others, more fertile in conjecture, reckon not fewer than 400 separate rooms. The capacity of the ark is described by Moses to be 300 cubits in length, 50 in breadth, and 30 cubits in height; but the dimensions are vaguely conjectured, from the indeterminate length of the cubit. Some determine the length of the ark to be 550 feet, others 450 feet, and the breadth and height in proportion. According to the first dimensions, the cubit is calculated at nearly 22 inches, and, according to the last, at rather less than 18 inches. Of the *time* of the construction of the ark, it is most generally supposed that the building commenced in 1536 and was completed in 1656 from the creation of the world, and including a period of 120 years. The *place* assigned for its construction has been variously represented by different writers, as Palestine, Mount Caucasus on the borders of India, some part of China, and the country of Babylon in Chaldea.

ARKWRIGHT, Sir Richard, a celebrated manufacturer, who, by his ingenuity in the invention of cotton-spinning machinery, raised himself from a humble station in life to rank and opulence. About the year 1767, after he had relinquished the trade of a barber, which was his original employment, he made a visit to Warrington; and being occupied with the long sought for discovery of the perpetual motion, he applied to Mr Kay, clock-maker of that place, to construct a piece of machinery with this view. From Kay, it is said, he derived the first hint of directing his mechanical invention to the more profitable construction of a machine for spinning cotton, and such a machine Kay described to him. By their united efforts the machinery was completed; Arkwright obtained a patent in 1769, renewed it in 1775, but it was set aside ten years afterwards; and having entered into partnership with Mr Smalley of Preston, the business commenced. But being unsuccessful, they removed to Nottingham, assumed wealthy partners, and erected a large cotton-mill, which was driven by horses.

The machinery was still farther improved, establishments on a larger scale were formed, the business spread throughout the kingdom, and 20 years had scarcely elapsed, when it assumed a magnitude and importance, whether the amount of capital or the number of persons employed, or its value as a great national concern be considered, which far exceeded all the estimates of the most sanguine speculation. By the spirited exertions of the late Mr Dale of Glasgow, the cotton-spinning trade was early introduced into Scotland, and soon became a formidable rival to the parent establishments.

A claim in favour of Mr Kay, as the original inventor of this wonderful machinery, has been advanced; but as the share which that ingenious mechanic had in the invention and prosecution of the improvement is not specified, the merit to which he is justly entitled cannot now be ascertained. His name is never associated with those who were concerned in the progress of the discovery, although the omission is not to be regarded as positive evidence that he had no right to its honours and emoluments.

In the year 1786, Mr Arkwright, whose name was now well known in every part of the kingdom, and whose ingenuity was rewarded with the possession of great wealth, was appointed by the high sheriff and Hundred of Wirksworth to present an address to the king, and on that occasion he received the honours of knighthood. He died in August 1792 at his works at Crumford, in Derbyshire.

ARLES, a city in the department of the Mouths of the Rhone, in France; stands on the declivity of a hill on the eastern bank of that river, and in the midst of a rich and fertile country, although in some places covered with marshes, and includes about 18,000 inhabitants. This city had risen to great celebrity in the time of Julius Cæsar, and it still exhibits numerous splendid remains of Roman antiquities in the ruins of two temples, a triumphal arch, and an amphitheatre, 400 yards in circumference, and above 100 feet in height. A granite obelisk, 58 feet high and 7 feet diameter at the base, supposed to have been brought from Egypt by the Romans, was dug up in a garden in 1675, was adorned with the arms of France, and dedicated to Louis XIV. A fine statue of Diana, discovered in 1651 among the ruins of the amphitheatre, adorns the gallery at Versailles.

ARMADA, an appellation used by the Spaniards to denote a fleet of men of war, but it is commonly restricted to the immense armament which was fitted out by Philip II. for the invasion and conquest of England. This armada, on which the Spaniards, with no small degree of confident presumption, bestowed the title of *Invincible*, was composed of 150 ships, most of which were superior in strength and magnitude to any which had before been constructed, navigated by 8000 sailors, and having 20,000 veteran troops, beside 2000 volunteers, many of them from the first families in Spain, on board. The number of great guns amounted to 2650, beside a copious supply of military stores. The fleet was provisioned for six months. The resources of England seemed to offer but a feeble opposition to this immense force, but the deficiency of means was well supplied by caution and prudence. All ranks vied with each other in equipping ships to strengthen the naval armament of the nation, and all capable of bearing arms flocked to the shores of the channel. Queen Elizabeth herself was seen in the camp at Tilbury, encouraging her troops, and, by her cheerful and undaunted manner, contributed much to rouse the drooping spirits of the kingdom.

The armada was ready to sail from Lisbon, the place of rendezvous, in May 1588; but the death of the commander, and a storm after leaving port, which required it to return for repairs, caused delay. At last it appeared in the English channel. Sir Francis Drake, the admiral of the English fleet, annoyed it greatly by his lighter and more manageable ships. Two large ships of the Spaniards, one of which took fire, and the other sprung her mast, were outsailed by their own fleet, and fell into the hands of the English, with very considerable treasure. The armada anchored off Calais; the English fitted up eight small vessels as fire-ships, and sent them among the enemy in the night. This destructive stratagem produced great disorder; the Spaniards cut their cables, and fled in the utmost precipitation; the English attacked them next morning; and beside dispersing the fleet, took or destroyed twelve of their large ships. No farther offensive operations could be attempted; the object of the Spanish commanders was now to retreat homewards; but contrary winds forced them to undertake the circuitous voyage by the north of Scotland. Many of the ships were wrecked on the coasts of Scotland and Ireland; and such was the disastrous issue of this remarkable expedition, that not more than half of the ships and men which sailed in it ever returned.

ARMADILLO, from the Spanish, signifying *armed*, the appellation of a tribe of quadrupeds which is furnished with a testaceous covering like a coat of mail. See *Dasypus*, under MAMMALIA.

ARMAGH, a county of the province of Ulster in Ireland, bounded by Lough Neagh on the north, Tyrone and Monaghan on the west, Louth on the south, and Down on the east, stretching from north to south about 32 miles, and about 20 miles in breadth, and including an area which is estimated at more than 450 square miles. The face of this county is finely diversified with gently rising hills, and in many places the soil is rich and fertile; but the mountainous district, called the Fews, presents a rugged and barren aspect, and is chiefly occupied as pasture land. The farms are in general of small size, and the improvements in agriculture are gradually adopted. Corn, flax, and potatoes are the chief crops.

The Blackwater, which is partly navigable, and divides the county from Tyrone, is one of the principal rivers; and Lough Neagh, which is 15 miles long and seven miles broad, receives the waters of seven rivers, and has only one outlet, the Ban, to the north, and the banks of which are partly flat and marshy, and partly rocky and precipitous, is the principal lake connected with the county. Strata of limestone are abundant in Armagh, and marble of a beautiful appearance is sometimes dug out. Some indications of lead ore and other metals have appeared, but have not been prosecuted.

Armagh, the metropolitan see, is the largest province of Ireland, and includes ten dioceses. The population is estimated at 130,000. The inhabitants of the mountainous districts are chiefly Roman catholics; the protestants amount to one-third of the whole population, and of this class the presbyterians form the largest proportion. The linen manufacture in its various branches affords extensive employment to the inhabitants of Armagh, and its annual average value has been estimated at L.300,000.

ARMAGH, the capital of the county of the same name in Ireland, is said to have been the seat of a university soon after the establishment of Christianity, and in the 12th century was constituted by the Pope's legate the metropolitan see. The primacy is reputed to be worth L.8000 annually. The palace of the archbishop is a fine edifice; and the schoolhouse, which adds to the beauty of the place, is richly endowed. The linen market of Armagh is one of the most extensive in the province; and the banks of the Callen, near the town, are covered with bleaching grounds. Armagh is 62 miles from Dublin.

ARMENIA, a country of Asia, having the Euphrates as its boundary on the west, Diarbekir on the south, Persia on the east, and Georgia on the north, and exhibiting a varied aspect of bleak mountains and fertile vallies. The elevated districts afford pasture to numerous herds and flocks; and the fertile soil of the low lands, in a temperate climate, yields abundance of corn, wine, and excellent fruits. In some places tobacco is extensively cultivated. The mountainous regions are subject to severe cold; and the droughts in summer require the husbandman to have recourse to frequent irrigation. Rock salt is dug from quarries, and, beside what is consumed in the country, is transported on the backs of buffaloes to Persia.

Christianity was early established in Armenia. The church establishment is composed of patriarchs, archbishops, doctors, secular priests, and monks. They have seven sacraments, and at certain seasons subject themselves to rigid abstinence and frequent fastings. The Turkish inhabitants of Armenia profess the Mahometan faith. The manufacture of tapestry and of silk and woollen stuffs is successfully conducted in various districts; and the mercantile enterprise of the Armenians is celebrated throughout every part of the civilized world. Erzerum is the capital.

The history of Armenia refers to the conquest of their country by the Assyrians, the Medes, and the Macedonians. Two prefects under Antiochus the Great threw off their dependence, assumed regal power, and divided the country into Armenia Major and Minor, a division which remains to the present day. An alliance with the Romans strengthened their authority, and secured them in their possession. The Armenians maintained a vigorous struggle with the Romans, but were at last defeated with great slaughter by Lucullus their famous general; they were afterwards governed by their own kings, but in the character of allies or tributaries to Rome, and in the time of Trajan were reduced to the form of a Roman province. Restored to the appearance of independence, Armenia could again boast of being ruled by its own sovereigns, who performed homage to Constantine the Great. But in the time of Justinian II. it was conquered by the Saracens, and held under their dominion till the irruption of the Turks, who changed the name to Turcomania. The invasion of Persia by the Turks drew off their forces, and afforded the Armenians an opportunity of resuming their independence, which they retained till the Tartars made themselves masters of their territory. The ancient kings seem to have been restored; for, in 1472, a sovereign of Armenia succeeded to the crown of Persia, and annexed his native dominions as a province to that empire. But, in 1522, Armenia was finally subdued by Selim II. and excepting some part of the eastern territory, which is claimed by Persia, has continued to the present day subject to the Ottoman Porte.

ARMILLARY, in its general signification, is applied to something composed of rings or circles; as the *armillary* sphere, which consists of a number of circles representing the imaginary divisions of the world, and so arranged as to aid the conception in studying the motions and relative positions of the heavenly bodies.

ARMINIANISM, the peculiar doctrines which were held by Arminius, a protestant divine, and a native of Holland, who was born in 1560, settled as a minister in Amsterdam in 1588, and about the beginning of the 17th century was appointed professor of divinity at Leyden. He was greatly distinguished for the integrity of his character, and the extent of his learning. He died in 1609. Arminius was engaged by Martin Lydias, professor of divinity at Franeker, to refute the opinions of certain clergymen at Delft, concerning predestination; but in the progress of the investigation he not only adopted the doctrine which he had undertaken to oppose, but carried it still farther; and thus originated the opinions which bear his name.

The peculiar tenets of the Arminians refer to predestination, universal redemption, the corruption of man, conversion, and perseverance. 1. On the first point it is maintained, "That God, from all eternity, determined to bestow salvation on those who he foresaw would persevere unto the end in their faith in Jesus Christ, and to inflict everlasting punishment on those who should continue in their unbelief, and resist unto the end his divine succours; so that election was conditional, and reprobation in like manner the result of foreseen infidelity and persevering wickedness.

2. On the subject of universal redemption, they held, "that Jesus Christ, by his sufferings and death, made an atonement for the sins of all mankind in general, and of every individual in particular; that, however, none but those who believe in him can be partakers of their divine benefit."

3. With regard to the corruption of man, the Arminians taught, "that true faith cannot proceed from the exercise of our natural faculties and powers, nor from the force and operation of free-will, since man, in consequence of his natural corruption, is incapable either of thinking or doing any good thing; and that therefore it is necessary, in order to his conversion and salvation, that he be regenerated and renewed by the operation of the Holy Ghost, which is the gift of God through Jesus Christ."

4. The doctrine of conversion maintained by the Arminians is, "that this divine grace, or energy of the Holy Ghost, begins and perfects every thing that can be called good in man, and consequently all good works are to be attributed to God alone; that, nevertheless, this grace is offered to all, and does not force men to act against their inclination, but may be resisted and rendered ineffectual by the perverse will of the impenitent sinner."

5. On perseverance, they held the opinion, "that God gives to the truly faithful, who are regenerated by his grace, the means of preserving themselves in this state." The first Arminians expressed some doubts of this doctrine, but their followers maintain, "that the regenerate may lose true justifying faith, forfeit their state of grace, and die in their sins."

Arminius promulgated his opinions when he was professor of divinity at Leyden. The controversy with the Calvinists, to whose doctrines they were opposed, became more general and more violent after his death, and at one time threatened the country with the calamities of civil war. The synod of Dort, which was assembled by orders of the states-general, and was composed of delegates, not only from the United Provinces, but from the reformed churches of Switzerland, Germany, and England,—condemned the followers of Arminius unheard, and declared them to be guilty of pestilential errors, and corrupters of true religion. This decision subjected those who were charged with Arminianism to severe persecution; they were stript of their employments; the clergy were silenced, and their congregations were suppressed. But on the death of Prince Maurice, in 1625, who had keenly espoused the Calvinistic side of the question, they were fully restored to their former privileges; and, under the toleration of the legislature, they erected churches, and established a college at Amsterdam.

ARMONIAC, or sal armoniac, the old name for sal ammoniac, or muriate of ammonia. See CHEMISTRY.

ARMOUR, a defensive habit, which was formerly employed to cover and protect the body from the attacks of an enemy. A complete suit of armour was composed of the casque or helmet, gorget, cuirass, gauntlet, tasses, brassets, cuisses, and covers for the legs, to which the spurs were attached. This furniture was denominated *armour cap-a-pee*, or from head to foot, because the whole body was covered with it, and it was worn by cavaliers and men-at-arms. The head-piece, the cuirass, and tasses only, and of a lighter construction, were worn by the infantry. But defensive armour is entirely laid aside in the modern warfare of civilized nations, with the solitary exception of the cuirass, which was worn by Bonaparte's Imperial Guard at the memorable battle of Waterloo; but it seems to have formed a feeble defence against the powerful onsets and dauntless intrepidity of their brave opponents, who trusted only to their offensive weapons, to which the result of that battle, and the numerous cuirasses which have reached this country, and have become a kind of mercantile commodity, bear ample testimony. While defensive armour was in use, its various parts were constructed of different materials in different nations and in different periods of society. See Grose *on Ancient Armour*.

ARMS is a general appellation for all kinds of weapons, whether of an offensive or defensive nature. The various offensive weapons, which were formerly in use among civilized nations, have given place to the sword and to fire-arms.

Arms or armories are marks of dignity and honour, composed of certain figures and colours, authorised by the sovereign, and borne on banners, shields, coats, and hence they are called coats-of-arms, for the distinction of persons, families, and states. See HERALDRY.

ARMSTRONG, JOHN, a physician, poet, and miscellaneous writer, was born about the year 1709, in Castleton parish in Roxburghshire, in Scotland, where his father was clergyman; studied at the University of Edinburgh, and was admitted to a medical degree in 1732; and soon after settled in London, where it is supposed he supported himself by his literary talents. In 1735, he published a humorous essay on the empirical practice which then prevailed in the metropolis. A medical work appeared in 1737, which was soon after followed by the *Economy of Love*, a licentious production, which, whatever be its poetical merit, is not very creditable to the feelings of the author; but a corrected edition, which was published after an interval of several years, shewed that he was not insensible of its hurtful tendency.

In 1744, the public were gratified with the best production of his muse, *The Art of preserving Health*, a poem which still enjoys a high degree of celebrity, and is regarded as equal to any other of a didactic character in modern times; and although it has been perhaps justly charged with too frequent allusions to classical antiquity, it is to the excellence of this poem that Armstrong is indebted for having his name associated with the votaries of the British muse. His poems on *Benevolence*, and on *Taste*; the *Forced Marriage*, a tragedy; *Sketches on various Subjects*, under a fictitious name; a volume of *Medical Cases*, with some miscellaneous and fugitive pieces,—make up the list of Dr Armstrong's literary productions, but add little to his fame.

Dr Armstrong accompanied the army in Germany as physician in 1760, and made another visit to the continent at a later period of his life. His medical practice seems to have been extremely limited; and his want of success is ascribed by himself or his friends to a deficiency in those winning arts and prepossessing manners which are oftener better fitted to ensure popularity than more solid but less obtrusive talents. But the indolence of his character, and the literary retirement which he loved, are supposed to have been the chief causes of his failure. He died in 1779.

ARNE, Thomas Augustine, an eminent musical composer, was born in London in 1710. During his residence at Eton, his strong predilection for music began to appear, and became so powerful, that, on his return to his father's house, he concealed an instrument in his apartment, and muffled the strings with a handkerchief, that the sounds might not be heard by the family. Destined by his father for the profession of an attorney, the irresistible bent of his inclination was ill suited to the plodding application which it required, and he was at last permitted to pursue his favourite studies as the business of his life. Dr Arne was first known to the public as leader of the band at Drury-lane Theatre; and his first musical composition, which was for Addison's opera of Rosamond, was successfully performed in 1733. Beside numerous pieces of a lighter description, as ballads, duets, and trios, which were performed at Vauxhall, the music which he composed for Fielding's burletta of *Tom Thumb*, the *Comus* of Milton, the opera of *Artaxerxes*, translated from the Italian of Metastasio, and Mallet's *Masque of Alfred*, in which the popular song of Rule Britannia first appeared, added to the celebrity, and extended the fame of the author. As a composer of oratorios, and in some musical entertainments, in which he furnished both the poetry and music, he was less successful. He received the degree of Doctor of Music from the university of Oxford, and he died in 1778.

ARNE, a river of Switzerland which derives its origin from the Alps, falls into the Rhone near Geneva, by its greater velocity preserves its own current for some miles distinct from the more placid stream of the Rhone.

ARNHEIM, the capital of Lower Guelderland, and formerly one of the Hanse towns, stands on the right bank of the Rhine, near its junction with the river Yssel, is strongly fortified with ramparts, as well as with a deep ditch on one side and the Rhine on the other. The walls are adorned with rows of trees; the streets are regular; and many of the houses are not deficient in elegance. The population is stated at 15,000; and the navigation of the Rhine, and artificial canals, afford numerous facilities to commercial activity.

ARNICA, Leopard's Bane, a genus of plants belonging to the Sygenesia class. *Arnica montana*, a native of Germany, was once in some repute in paralytic and feverish disorders; but its effects were probably overrated.

ARNO, the ancient Arnus, a river of Italy, which has its source in the Appenines, passes through Florence and Pisa, and falls into the Tuscan sea eight miles below the latter town.

ARNOLD, Samuel, an eminent musical composer, was born in 1739, was a pupil in the chapel-royal, St James's, London; was first known to the public by the beautiful and admired air, *If 'tis joy to wound a lover*; was appointed musical composer to Covent-garden Theatre in 1760; he was preferred to the same situation in the Hay-market Theatre in 1776; in a few years afterwards succeeded to the place of organist and composer to the royal chapel at St James's; and in 1796 was chosen director of the annual festival at St Paul's before the sons of the clergy. The university of Oxford conferred the degree of Doctor of Music on Mr Arnold on the installation of a chancellor, when he presided at the performance of the oratorio of the *Prodigal Son*, which is his own composition. The death of this celebrated composer happened in 1802.

The *Cure of Saul*, which was set to music in 1767, the oratorios of *Abimelech*, the *Resurrection*, and the *Prodigal Son*, and the popular performances of the *Maid of the Mill*, *Inkle and Yarico*, the *Agreeable Surprise*, the *Surrender of Calais*, *Peeping Tom*, and the *Shunamite Woman*, afford ample proof of the musical genius of Dr Arnold. He published four volumes of cathedral music, and superintended an edition of the works of Handel.

ARNOTTO, a dye-stuff, in the form of a hard paste, obtained from the seeds of *Bixa orellana*; for the mode of preparing which, See Annotto.

AROMATICS are such vegetable substances as have a fragrant penetrating odour, and a warm pungent taste. as ginger, pimento or Jamaica pepper, and caraway seeds.

ARPINO, the ancient Arpinum, a town of the Neapolitan territory, and celebrated as the birth-place of Caius Marius and Cicero. It is curious to remark that the family seats of these two renowned characters of antiquity are both occupied by monastic establishments.

ARRACAN, a country or province of Asia, and also the capital of the province. See Aracan.

ARRACK, or Arack, a spiritous liquor obtained from the fermented juice of different vegetable substances, as the tops of the cocoa-nut and other trees of the palm kind, from rice, and the liquid which flows from an incision or cut branch of the palm trees.

ARRAGON, a province of Spain, having the Pyrenees on the north, Catalonia and Valencia on the east, New Castile on the south, and part of Navarre on the west, about 240 miles in length, and 160 in breadth, and greatly diversified in its aspect with lofty mountains, barren plains, and fertile vallies. The climate is in general temperate, but the higher regions are subject to severe tempests. The Ebro, Cinca, Segra, and Arragon, are the chief rivers.

Natural History.—Arragon has been celebrated for its mineral productions from the time of the Romans. Copper ore is dug out in some places; indications of gold and silver have been observed; cobalt was discovered in the beginning of the 18th century, and wrought for more than 50 years, and the iron of this province is esteemed of a superior quality for sword-blades; marble, gypsum, jet, and rock-salt are abundant; and aluminous schistus affords a rich and pure material for the manufacture of alum. Extensive tracts are covered with Spanish oak, the most stately of the vegetable tribe in the province; the hills are clothed with pines, and numerous plants of humbler growth, as juniper, *cistus*, or rock-rose, and *arbutus uva ursi*, or trailing arbutus, adorn the heathy moors, or conceal the sterile aspect of the bare rock from the eye of the traveller. The bear and the wolf have their abode still in the mountainous recesses of Arragon; the lynx and the ermine are natives of the more elevated regions; and the stag, the ibex, and different species of the goat tribe are abundant. The sheep is the most important of its domestic animals. In the commencement of the 18th century, the stock of sheep in Arragon was estimated at a million and a-half. Beside numerous species of the feathered race, the vulture is common; and the golden eagle and the ptarmigan frequent the Pyrenees. The scorpion is a native of Arragon; and the ravages of the locust have oftener than once been followed by famine and pestilence.

Population, &c.—The population of Arragon, in 1788, exceeded 623,000, in which are included 10,000 priests and others, male and female, connected with religious institutions, and 9000 persons of the order of nobility. But extensive tracts of country are still altogether destitute of human habitations. Beside wool and silk, wheat, hemp, flax, saffron, and wine are enumerated among the productions of the more fertile districts. But husbandry is yet in a rude and imperfect state. The woollen manufactures once flourished, but are now less prosperous. Soap, glass, earthen-ware, gunpowder, and leather, are still the objects of industry to many of the inhabitants in different places of the province. Wheat, hemp, and wool, with woollen stuffs, silk, and stockings, are the only exports from Arragon. Saragossa, the capital, which, on account of its memorable siege during the invasion of the French in the beginning of the 19th century, must hold a conspicuous place in the annals of Europe, Alcarazin, Calayatud, Daroca, and Jacca, are the chief towns.

ARRAGONITE, a singular mineral production of Arragon, from which the name is derived, and which, on account of its form and hardness, has occupied much of the attention of mineralogists and chemists. See MINERALOGY.

ARRAIGNMENT is a law term, which signifies that part of a judicial process in which a person charged with a crime is called to the bar of a competent tribunal to answer an indictment. See Blackstone's *Commentaries.*

ARRAN, an island on the western coast of Scotland, about 22 miles long and nine or ten miles broad, presenting in the northern division a rugged surface of lofty mountains, and towards the south flat land of considerable extent fit for arable culture. Goatfield, rising to an elevation of 3000 feet above the level of the sea, rewards the fatigue of the traveller in the ascent, with a wide, varied, and rich prospect. Lamlash bay on the east side, and protected by an island of the same name, is one of the safest and most commodious harbours in the kingdom, and is capable of receiving a numerous fleet of ships of large burden.

Mineralogy.—Arran, including within a small compass, both primary and secondary rocks, presents a fine field of investigation to the geologist. The more elevated and central parts of the northern division of the island are chiefly composed of grey granite, in the cavities of which crystals of smoky quartz and crystallized feldspar are sometimes formed. Slaty or schistose granite or gneiss, micaceous and argillaceous schistus, appear in the lower regions. In the southern division of the island, red sandstone is the prevailing rock; and sandstone, limestone, bituminous shale, and a small deposition of blind coal, are met with on the north-eastern shore. Arran is the most copious repository of pitchstone which has been yet discovered. Thick veins of this mineral traverse the sandstone rocks. Small crystals of pistazite, a rare mineral in this country, line the fissures of the argillaceous schistus. Splendid masses of schistose porphyry, or clinkstone of a columnar form, appear in the lofty and precipitous cliffs of Lamlash island. The small island of Pladda, near the southern extremity, and on which a light-house is erected, consists chiefly of a similar rock. In some parts of Arran, other porphyritic rocks and basalt are not uncommon. The spacious caves in the sandstone on the west-side of the island, are usually visited by travellers as objects of curiosity.

Population, &c.—The greater part of Arran is the property of the Duke of Hamilton; two farms belong to the Marquis of Bute; and the family of Fullerton has held possession of a small estate for many centuries. The population of Arran is probably between 6000 and 7000. In 1798 it was estimated at 5800; and the population of the whole county, which includes Bute and some smaller islands, exceeds 12,000. The whole island is divided into two parishes. The only village is Lamlash, on the shore of the bay of that name. Agriculture, which is advancing in improvement, the fisheries, which are profitable, and the ordinary domestic manufactures, are the chief occupations of the inhabitants. Oats, barley, and potatoes are the principal crops; black cattle and some horses, with a little kelp made on the shores, are exported. The gross rent, stated a few years ago at L.5500, has no doubt increased with the progressive improvement of the soil and mode of husbandry. Numerous flocks of sheep and goats are reared in the elevated pastures. Various species of the genus *tetrao* are found in Arran. The black cock frequents the coppices; the partridge is common in the corn land; grouse abound in the heathy moors; and the ptarmigan select the loftier regions of the mountains for their retired abode.

Antiquities.—Numerous fragments of druidical remains are seen in different places of Arran. Ranza castle, now a ruin, near the north end of the island, from its massy appearance, seems to have been a place of considerable strength, and is said to have been once a royal residence. Brodwick castle, on a precipitous cliff not far from the eastern shore, is an old castellated structure, but of a less ancient period, and is the occasional residence of some part of the family of the chief proprietor.

ARRAS, the *Attrebatæ* of Cæsar, was formerly the capital of Artois, and is now the chief town of Pas-de-Calais in France; occupies an elevated situation near the river Scarpe, and is divided into two parts by a narrow valley, which is watered by a small stream. Arras is strongly fortified, and is adorned with many fine buildings. The cathedral is a grand edifice, in the Gothic style, and surmounted by a lofty tower. The brazen pulpit of another church, which is in the form of a tree, supported by two bears, is an object of singular curiosity. The population of Arras is estimated at 20,000. The manufactures of linen and woollen, which were formerly prosperous, declined during the revolution, and a porcelain manufactory shared the same fate. *Arras* hangings, a kind of tapestry, which, it is supposed, was first made in this place, derived its name from the town. Arras is 130 miles north from Paris, and 27 miles north-west from Cambray.

ARREST, is a law term, denoting the restraint of a man's person, for the purpose of enforcing his obedience to the law, and it is executed either in civil or criminal cases. See Blackstone's *Commentaries.*

ARRESTMENT, a term in the law of Scotland, which signifies the securing of the person of a criminal, or, in a more general sense, denotes the diligence by which a creditor detains the goods of a debtor in the hands of a third party till the debt be liquidated. See Bell's *Dictionary of the Law of Scotland.*

ARRIAN, a Greek historian, who was a native of Nicomedia, in Bithynia, and flourished at Rome under Adrian and the Antonines, in the second century. His talents and conduct raised him to high official situations, both in a civil and military capacity, and even, it is said, to consular dignity. Arrian was the author of numerous historical works, all of which have perished among the wrecks of time, excepting the history of the *Expedition of Alexander the Great,* a production which has been always respected for the accuracy and truth of the narrative, and which is not less admired for the elegance of its style, the correctness and purity of which are rarely surpassed in the classical ages of Greek literature. Arrian was the the disciple of Epictetus, and his learning and eloquence obtained for him the honourable appellation of the *second Xenophon.*

ARRIEGE, a department of France, in the vicinity of the Pyrenees, including more than a million of square acres, and a population exceeding 191,000, and Foix is the chief town. In some places abundance of grain, wine, and excellent fruits are raised, but the larger portion of the surface is mountainous. Iron ore is abundant, and furnishes materials to a number of forges. Some other metallic ores have been found; quarries of marble are in a state of activity, and the department is well supplied with mineral springs. The river Arriege, which has its origin in the Pyrenees, traverses the department, and mingles its waters with the Garonne, not far from Toulouse.

ARSACIDÆ, a race of kings of Parthia, which commenced with Arsaces, who was the founder of the monarchy, and from whom the appellative denomination is derived. Artabanus, the last of the race, was conquered by the Persians in the 299th year of the Christian era.

ARSENIC, a metallic substance, which, in some of its combinations, is well known for its poisonous qualities. When a substance is suspected to be arsenic, or to contain any portion of that metal, a little of it thrown upon a hot iron is an easy method of detecting the arsenic. If it rise in white fumes, with the smell of garlic, the suspicion is strongly confirmed.—See CHEMISTRY and MINERALOGY.

ARSON, an English law term for wilful fire-raising; a crime which, from its nature, and the dreadful consequences which may attend it, subjects its perpetrators to the highest punishment.—See Blackstone's *Commentaries.*

ART has been defined a proper disposal of the things of nature, by human thought and experience, to be accommodated to the purposes of mankind. But art is chiefly used to denote a system of rules according to which certain actions are performed, as the art of brewing, baking, and carpentry: and in this sense art is opposed to science, which investigates the principles of art, and constructs the system of rules by which it is practised.

Arts are usually arranged under two heads, *useful* or *mechanical* arts, and *liberal, polite,* or *fine* arts. The first, which are also distinguished by the name of *trades,* require little more in their practice than manual dexterity; and hence they are called mechanical, and useful, because they are limited to the wants and uses of mankind. The liberal or the fine arts depend on mental exertion for their successful cultivation; such are, poetry, painting, music, sculpture, and architecture. Some writers even restrict the term *fine arts* to painting and sculpture; and hence it is obvious, that as the definition is framed on a wider or narrower scale, it may exclude some, or embrace all that are usually enumerated under this denomination. Utility is the object of the mechanical arts; but the object of the liberal arts is to excite agreeable sensations.

ARTA, a town of Albania, supposed by some to be the ancient Ambracia, stands in a fertile plain, which produces abundance of Indian corn, wheat, rice, and tobacco, and is at no great distance from a gulf of the same name. The approach to Arta is described as remarkably beautiful. The woods and plantations of fruit-trees in its immediate vicinity, and the mountainous amphitheatre which closes the view, form a striking and picturesque scene. Arta is the chief emporium of the southern districts of Albania; the population is estimated at 6000; and the distribution of the extraordinary number of places of worship into twenty-four Greek churches and six mosques, may serve to indicate the proportion of the Christian and

Mahometan inhabitants. The nature of the trade, which is chiefly in the hands of Greeks and Jews, has been already noticed in the account of Albania.

ARTEDI, Peter, an eminent naturalist, was born in 1705, in the province of Angermanland in Sweden; and being destined for the church, he fixed his residence at the university of Upsal, in 1724. But the strong bias to the study of natural history which had seized his mind, superseded every other pursuit; and when Linnæus was admitted a student in the same university in 1728, kindred studies soon united the two naturalists in the warmest and closest friendship. While other departments of science and natural history were not neglected, especially chemistry and botany, Artedi devoted a large share of his attention to the classification of fishes; and, for the purpose of prosecuting his favourite investigation, he visited England in 1734. The state of his finances had been always extremely circumscribed; but on his return to the continent the succeeding year, when he fortunately met with his friend Linnæus at Leyden, he was altogether destitute of the means of subsistence. The avocations of Linnæus prevented him from contributing his aid to the splendid compilation of natural history, which was undertaken and published by Seba, a learned apothecary of Amsterdam. Artedi was recommended, zealously commenced his labours in the department of fishes, and had nearly brought them to a close, when, returning from Seba's house to his lodgings, in a dark night, he fell into a canal, and was unfortunately drowned, in September 1735.

Before their separation at Upsal, Linnæus and Artedi had entered into a mutual agreement to bequeath the unpublished literary productions of each other to the survivor. Linnæus hastened to Amsterdam to claim the manuscripts of his departed friend, recovered them through the liberality of Mr Clifford, a rich citizen, who generously discharged a debt for which they were retained, and published at Leyden, in 1738, the *Bibliotheca Ichthyologica* and *Philosophia Ichthyologica*, with a biographical sketch of the author.

ARTEDIA, a genus of plants belonging to the Pentandria class.

ARTEMIDORUS, an author of some celebrity on account of his zeal and industry in collecting materials for his work on dreams. He was a native of Ephesus, and lived in the time of Antoninus Pius. To procure information on his favourite pursuit, no expense was spared in purchasing all the books on the subject within his reach, and no labour was avoided in travelling to foreign countries, or in keeping up a correspondence with individuals in distant regions. The *Oneirocritica* was published in Greek, in 1518; and Artemidorus is the author of a treatise on *Augury* and *Chiromancy*, or *Palmistry*, subjects of a kindred nature.

ARTEMISIA, a queen of Caria, and wife of Mausolus, whom she survived, and to whose memory she erected a most magnificent tomb, which was celebrated as one of the wonders of the world, and was called *Mausoleum*, from the name of the king; and hence the same name is applied in the present day to splendid monuments of the same nature.

ARTEMISIA, a genus of plants belonging to the Syngenesia class, and including the well known *Southern-wood*, *Wormwood*, and other bitter and aromatic plants.

ARTERY, is applied to the blood-vessels which convey the blood from the heart to the extremities of the body. By the veins the blood is reconducted from the extremities to the heart.

ARTICLE, a term of various signification, as denoting a clause or condition of a treaty or contract, the subdivision of a discourse or writing, a point of doctrine in religion, and a particle prefixed to nouns in different languages; as in the English language, *the* and *a*, the first of which is the definite article, as *the* man, and the second is called the indefinite, as *a* man.

ARTIFICER, a person who is employed in mechanical operations, or who manufactures any kind of commodity by means of manual dexterity, as iron, wood, flax and wool, and hence is denominated a smith, carpenter, or weaver. Artificers have been always regarded as an important class of citizens in the improved periods of society, and strict laws and regulations have been enacted for their conduct. Without referring to the rank and consideration in which artificers were held among the ancient Romans, it may be worth while to notice the laws of our own country relative to that class of society. By the law of England artificers going out of the kingdom, into any foreign country, without licence, are subjected to three months imprisonment, and a fine of L.100; and such as go abroad, and do not return within six months, after warning from the British ambassador, are treated as aliens. Those who seduce artificers to settle abroad incur a fine of L.100 and three months imprisonment; and if guilty of a second offence they are liable to a year's imprisonment, and a discretionary fine. Those who contract with artificers to settle in foreign countries are subjected to a fine of L.500, and a year's imprisonment, for each artificer contracted with. For the second offence the penalty is L.1000, and two years imprisonment. Masters of ships who give facility and effect to such contracts, are also subject to heavy penalties.

ARTILLERY, a term which, in its original signification, was applied to archery, in a general sense denotes the offensive apparatus of war, especially of a missile kind; but, in a more restricted sense, it comprehends the heavy equipage of war, as cannon, mortars, howitzers, balls, shells, &c. which otherwise come under the denomination of *ordnance*. The term *artillery*, or royal artillery, is also applied to the persons who are employed in that service, as well as to the art or science itself.

ARTILLERY PARK is that place, in a camp, which is appropriated to the artillery.

ARTILLERY TRAIN, a number of pieces of ordnance mounted on carriages, with all their equipage, ready for service.

ARTILLERY COMPANY, an association of the citizens of London, which was first instituted in 1585. In a short time this body increased to three hundred; and in 1588, when the whole kingdom was thrown into the utmost consternation and alarm by the invasion of the Spanish armada, some of the members held commissions from the queen. In 1611 the company was revived and amounted to 6000. The artillery company is now a corps of infantry, composed of gentlemen of property, to which a division of archers is attached.

ARTIST, in its general signification, is applied to a person who is skilled in the knowledge or practice of some art; but, in a more restricted sense, is limited to a proficient in some of the fine arts, as painting, engraving, sculpture, or architecture, and in this sense it is opposed to artificer or artizan, signifying a person who is occupied in a mechanical art.

ARTOCARPUS, THE BREAD FRUIT TREE, a genus of plants belonging to the Monoecia class, and including two species of that remarkable vegetable production. See BOTANY.

ARTOIS, a late province of France, and one of the most fertile in the kingdom, is now included in the department of the Straits of Calais, has a considerable trade in grain, flax, woollen and linen cloth, and some of the chief towns are, Arras the capital, Bethune, St Venant, and St Omer.

ARVALES FRATRES were a college of twelve priests, among the Romans, which was instituted by Romulus, and selected from the families of the first rank in the state. They officiated in the sacrifices of the *Ambarvalia*, which were annually offered to Ceres and Bacchus, for an abundant harvest.

ARUM, WAKE-ROBIN, or CUCKOWPINT, a genus of plants belonging to the class Gynandria, one species of which, *maculatum*, is a native of Britain.

ARUNDEL, a market-town of Sussex, in England, which stands on the declivity of a hill, on the banks of the river Arun. The river is navigable for small vessels; the population is about 2000; coarse cloth, for hop bags, is manufactured, and timber in considerable quantities is shipped for the dock-yards. The ancient castellated mansion, belonging to the Duke of Norfolk, which has been lately repaired, is a fine ornament to the town. Arundel is 55 miles south-west from London.

ARUNDELIAN MARBLES, are ancient monuments which were collected in Greece, or in the islands of the Archipelago, at the expence of Thomas Howard, Earl of Arundel, and from him the name is derived. They were presented to the university of Oxford by his grandson, and hence they are called the *Oxford marbles*; and the inscriptions, according to some opinions, having been executed in the island of Paros, they have received the name of the *Parian Chronicle*. During the residence of the Earl of Arundel in Italy, he employed Mr William Petty, a learned antiquary and profound classical scholar, to travel in Greece, and the contiguous islands, for the purpose of purchasing and collecting whatever remains of antiquity should fall within his reach. The fruits of this expensive, and often hazardous enterprise, was the splendid collection, composed of 37 statues, 128 busts, and 250 tablets of marble, with inscriptions, besides gems and other fragments, and the whole reached England in 1627. The marbles containing the inscriptions were inserted in the garden-wall of Arundel-house, in London, and immediately attracted the notice of antiquaries, and especially of the learned Selden, who transcribed a number of the inscriptions, and published them under the title of *Marmora Arundeliana*. But these curious fragments suffered great depredations during the civil wars; and when they were presented in 1667 to the university of Oxford, the number of stones was reduced to 130. The learning, industry, and ingenuity of the antiquary, were again occupied in decyphering and explaining the inscriptions. Dean Prideaux published *Marmora Oxoniensia* in 1676; the work of Maittaire on the same subject appeared in 1731; and Dr Chandler brought forward a new edition in 1763. Doubts of the authenticity of the inscriptions had been occasionally thrown out by different authors, although a contrary opinion was most generally adopted; but the claims for the high antiquity of these monuments has been more formally challenged by Mr Robertson in his work entitled the *Parian Chronicle*, than by any former author, and the objections urged against their alleged authority are stated with much learning and ingenuity. But for a full detail of his arguments, the reader, interested in such curious researches, is referred to the Essay itself, as well as to *The Vindication of the Parian Chronicle*, by Hewlet; and to Dallaway's *Anecdotes of the Arts*.

ARUNDO, the Reed, a genus of plants belonging to the Triandria class.

ARUSPICES, or HARUSPICES, an order of priests among the Romans, who presided at sacrifices for the purpose of inspecting the entrails of the victims which were offered, and from their aspect, as well as from other incidents which attended the sacrifice, of announcing whether the omens were favourable or adverse. The observations of the aruspices were derived from the appearance of the victims before they were killed, and of the entrails after they were cut up, from the flame which arose from the altar during the burning, and from the flour, frankincense, and wine, used in the sacrifice. The same priests were consulted concerning portents and prodigies, to declare what were the omens to be learned from such preternatural appearances. This order was selected from the best families in Rome.

ARZILLA, a sea-port town in Morocco, which stands at the mouth of a small river which flows into the Atlantic ocean, was originally a Roman colony, was afterwards taken by the Goths, and finally came under the dominion of the Mahometans, who adorned it with many splendid edifices. The inhabitants, who are chiefly Moors and Jews, amount to about a thousand.

AS, a Roman weight and coin. The weight was equal to 12 ounces, or the Roman pound. The coin of the same name varied in weight and value at different periods of the commonwealth, and it was composed of different materials, as wood, leather, shells, and brass. The weight, originally 12 ounces, was reduced at different times, till at last it was diminished to half-an-ounce.

ASA-*Fœtida* is the concrete juice, or extract, of an umbelliferous plant, which is a native of different regions of Asia. See *Ferula*, under MATERIA MEDICA.

ASAM, a country of Asia. See ASSAM.

ASAPH, ST. a small town of Flintshire, in England, with a population little exceeding 1500, and chiefly known as being the see of a bishop. The situation of St Asaph is in a fertile valley, at the confluence of two rivers, and it is 20 miles distant from Chester.

ASARUM, Asarabacca, a genus of plants belonging to the Dodecandria class.

ASBESTUS, or Asbestos, a mineral substance belonging to the Magnesian genus, and of which the ancients manufactured their celebrated incombustible cloth. See Mineralogy.

ASCARIS, a genus of worms belonging to the order Intestina. See Helminthology.

ASCENSION, an astronomical term, which is said to be either right or oblique. *Right Ascension* is an arch of the equator, intercepted between the equinoxial point, or the first of Aries, and the hour circle of any planet or star. *Oblique ascension* is that point of the equinoxial which comes to the horizon with any of the planets or fixed stars.

ASCENSION ISLAND, an island in the Atlantic ocean, discovered by the Portuguese in the beginning of the 16th century, is about 10 miles in length, and 6 or 7 miles in breadth. The shores in many places are covered with a fine sand of dazzling whiteness, and the surface of the interior regions presents a mass of rugged rocks, piled on each other in great disorder, with a few spots on which some scanty herbage finds nourishment, but no tree or shrub has yet reared its head to conceal its parched and barren aspect. Limestone seems to be the prevailing rock. A peculiar species of grass, *Aristida Ascensionis*, is the most common of the vegetable productions, five different species of which were all that Osbeck, who visited the island before the middle of the 18th century, could discover. Turtles of large size, and fish, are abundant round the shores; land crabs are common; it is the frequent resort of numerous sea-fowl; and goats, the breed of which had been left by early voyagers, have greatly multiplied. A volcanic origin is ascribed to this island by those who describe its appearance. S. Lat. 8° and W. Long. 14°.

ASCETIC, from the Greek, signifying *to exercise*, an appellation applied to a person who subjects himself, from religious motives, to severe mortification and penance.

ASCHAM, Roger, a learned Englishman, who was greatly distinguished by his classical literature, was a native of Yorkshire, and was born in 1515. His parents were remarkable for having terminated the long period of 67 years of a happy married life on the same day and nearly in the same hour. Of them it might be justly said, they "were pleasant in their lives, and in their death they were not divided." Adopted into the family of Sir Anthony Wingfield, and placed under the care of the tutor of his sons, young Ascham made rapid progress in classical literature. In 1530, by the generosity of his patron, he was admitted a student in Cambridge; and the new studies of literature, and new tenets of religion, which had just begun to dawn on the world, gave full employment to all who were desirous of truth or ambitious of fame, and failed not to awaken the energies of his youthful mind. The Greek language was the first object of his study; and such was his zeal and ardour to become a proficient in its knowledge, that, even in his boyish years, he read lectures to others who desired instruction. To this mode of improvement he was recommended by the advice of a friend, a warm admirer of Grecian literature, who, in a letter which is worthy of being recorded, assured him that he would gain more knowledge by explaining a fable of Æsop to a boy, than by hearing one of Homer's poems explained by another.

Soon after he was admitted to a bachelor's degree; in 1534, when he was in his 18th year, he was elected fellow of his college. His reputation as a Greek scholar rose high, and his chamber was often frequented by those who were eager to hear his lectures on Grecian literature. Three years afterwards he became master of arts, and commenced tutor, and soon after was appointed public lecturer on the Greek language, the first establishment of the kind in the university of Cambridge. Ascham had before this time learned to perform on musical instruments, and he excelled in the art of writing, particularly in the embellishment and illumination of the pages, mechanical accomplishments which were then greatly admired, and added much to his celebrity. These qualifications, and the elegance of his Latin composition, rendered him a fit person to write the public letters of the university. His feeble constitution, which was not invigorated by close study, required him to take exercise in the open air. Archery was his favourite amusement; and in a work on the subject, entitled *Toxophilus*, he delivers precepts for teaching the art, and strongly recommends the practice.

The talents and reputation of Ascham obtained for him the notice of Henry VIII., with a more solid mark of royal approbation in a pension of L. 10 a-year, a sum which now appears nominally small, but is supposed to be equal to L.100 in the present time. He succeeded to the office of orator of the university, and was at the same time employed in teaching the sons and daughters of the nobility the learned languages, and also in writing a fine hand. The princess Elizabeth and Prince Edward were among the number of his pupils. He was engaged for some time in directing the studies of the princess; but on some disgust which is not explained, he suddenly relinquished the employment, and returned to his retirement in the university. He visited Germany in the capacity of secretary to the English ambassador, and drew up a *A Report and Discourse of the Affairs* of that country. The death of Edward disappointed all his hopes. Recalled from his diplomatic situation, he returned to his fellowship in despair; but he recovered sufficient influence to be reinstated in the office of Latin secretary under Philip and Mary, with an annual salary of L.20; and a specimen of his laborious industry is recorded, in composing and transscribing, with great elegance, 47 letters in three days, addressed to princes and personages of the highest rank in Europe. It is not a little singular, that a protestant held so conspicuous a situation under that intolerant reign. When Elizabeth mounted the throne in 1558 he was continued in his office, and admitted to assist her in her studies, and even to share in her diversions; but this seeming favour added little to the improvement of his fortune. His only literary production during her reign was the *Schoolmaster*, or, a Treatise on Education, great part of which was composed under the pressure of pecuniary distress, occasioned either by the parsimony of the queen, or his own improvident expenditure. The bodily constitution of Ascham was never robust, but in the latter period of his life it was greatly enfeebled by intense study; and in his assiduous application in the composition of a poem which was to be presented to the queen on the anniversary of her accession, he was seized with an illness which brought him to the grave in 1568, leaving behind him the character of one of the most learned men and most accomplished scholars of the age. See *the Life of Ascham* by Dr Johnson.

ASCIDIA, a genus of Vermes belonging to the order *Mollusca*. See HELMINTHOLOGY.

ASCLEPIAS, SWALLOW-WORT, a genus of plants belonging to the Pentandria class.

ASCYRUM, PETER'S WORT, a genus of plants belonging to the Polyadelphia class.

ASHBURTON, a borough town of Devonshire, and one of the Stannary towns, in the vicinity of which the copper and tin mines are successfully wrought. The population exceeds 3000, some of whom are occupied in the manufacture of serges. The distance from Exeter is 19 miles.

ASHBY DE LA ZOUCH, a town of Leicestershire, with a population of nearly 3000, and having a considerable trade in malt, and 19 miles distant from Leicester.

ASHMOLE, ELIAS, a learned and industrious English antiquary, was born at Lichfield in the year 1617, and, after completing his education in the country, entered into the profession of an attorney in London. But when the civil war broke out he joined the army, and served in the ordnance department; and during his residence at Oxford in a military capacity, he enrolled himself as a member of one of the colleges, and prosecuted the study of mathematics, natural philosophy, and astrology. After the surrender of Worcester, Mr Ashmole went to London, where kindred pursuits introduced him to Lilly, Moore, and Booker, the celebrated astrologers of the age. A second marriage had greatly improved his fortune, and his house became the frequent resort of all those who were engaged in alchemical and astrological researches. He published a Treatise on Alchemy under a fictitious name, and made a collection of the manuscript works of English chemists, which appeared in 1652, with the title of *Theatrum Chymicum Britannicum*.

The studies of Ashmole took a different turn. Antiquarian researches seem to have occupied his attention during the remainder of his life. His work on *The Institution, Laws, &c. of the Order of the Garter*, published in 1672, acquired great celebrity. The loyalty of Ashmole was rewarded at the restoration of Charles, by his appointment to the office of Windsor herald and superintendant of the king's medals, besides some other lucrative situations and literary honours. He had made an extensive collection of coins; but his cabinet, which contained nine thousand coins, with his library and antiquities, was destroyed by fire in his apartments in the Middle Temple. His gold medals, and some valuable manuscripts, were fortunately preserved. Mr Ashmole had resided in the house of John Tradescant, the celebrated botanist, at Lambeth, and his collection of curiosities, which were bequeathed to him, along with his own books and manuscripts, formed the foundation of the Ashmolean Museum at Oxford, which is deposited in a building designed by Sir Christopher Wren. Mr Ashmole died in 1692.

ASIA.

ASIA is one of the larger portions of our globe, which, by its magnitude, the vast modifications of its features, the variety of its productions, the extent and antiquity of its population, merits very ample description; but as the constituent parts are to be particularly treated in the order of the alphabet, we shall at present confine our attention to some general topics in its natural history, and the progress of its discovery and civilization.

Extent, &c.—Asia is connected with Europe by the great chain of the Uralian mountains, and with Africa by the narrow isthmus of Suez. It lies, therefore, to the east of these continents, stretching out in a very irregular manner towards the Great Pacific Ocean, by which it is separated from the later known continent of America; while its southern shores are washed by the Indian Ocean, taken in its largest acceptation; and its limits on the north are defined by the ever-during ice of the arctic regions. The greatest length, supposed to be from the strait of Babelmandel, in Arabia, to a point at Behring's strait, in the north-east, exceeds 8000 British miles; and its breadth, reckoning from the southern cape of the peninsula of Malacca, to a cape in the north-west of Siberia, may be said to be 5000. The medial dimensions are, perhaps, 1000 miles less. This is altogether exclusive of a multiplicity of islands scattered around its coasts, particularly in the south and east, some of which are of magnitude sufficient to form considerable kingdoms.

The extreme irregularity of Asia will be best understood by inspecting a map. In artificial or scientific geography, it is said to be situate between the 26° and 190° of longitude east from Greenwich, and between the 2° and 77° of north latitude. Its most imperfect boundary is in the direction of Europe, being in a great degree arbitrary, and consequently variously assigned by different authors. It is enough for our purpose to conceive an imaginary line drawn from the Uralian mountains, already mentioned, to the small river Karposka, which rises near Sarepta, and runs into the Don, and to follow the course of this last river into the Black Sea, whence, through the Dardanelles to the Mediterranean archipelago, a natural and sufficient boundary is presented.

General appearance.—To a spectator, whose eye could take in the whole of this continent at one view, Asia would seem to consist of a vast elevated plain, bounded by mountainous ridges, whose declivities, proceeding in all directions, and in various lengths, formed the basis of many empires or states, only narrowly divided from each other by series of hills and rivers. This central elevation, which is some thousand miles in extent, is perhaps its most striking feature, distinguishing Asia from all the other continents, besides giving rise to a peculiar distribution of rivers, and at the same time materially influencing both its own temperature and seasons, and those also of another large portion of the globe, Europe. The plain itself is but scantily inhabited, and little known; few travellers having surmounted the natural difficulties with which it is environed, or choosing to trust themselves in the hands of the barbarians by whom it is possessed. On the north of the plain extends the bleak Siberia, doomed to almost perpetual winter, not so much from its geographical position as the height of its boundary, which interrupts the current of warm air from the more favoured countries of the south. These, again, which are the vast states generally classed under the title of India, and a large portion of the Chinese empire, are prevented, by the same arrangement, from experiencing the diffused severity of the polar clime. Towards the east of the plain, we find those parts of China and Chinese-Tartary which border on the Pacific ocean; and on the west are Persia and the countries extending from the vicinity of the Aral and Caspian seas towards the frontiers of Europe. Such is the most general distribution of the Asiatic lands; and several extensive tracts, not exactly included in any arrangement, may be considered as appendages. The chief of these are, that large space included between the Mediterranean, Red sea, part of the Indian ocean, the Persian gulf, and a line stretching from it towards the Black sea, and which comprehends Arabia, Syria, and Asia Minor, along with some smaller divisions, altogether forming the south-west border of Asia; the promontories of Kamtschatka, Sachalin, (conceived, according to Krusenstern, as not disunited from the continent by the the gulf of Tartary,) and Corea, on the east, and the still more important projection in the south, constituting the countries of Cochin-China, Cambodia, and Siam, with Malacca, projecting, as it were, between two seas. To all of which must be added, as at comparatively small distances, the extensive and sometimes grouped islands of Japan, Formosa, Hainan, Sumatra, Ceylon, &c. not to speak of many more which are farther off, and which, by an arrangement pretty generally adopted among modern geographers, enter into the formation of another large division of the globe recognised under the appropriate enough title of Australasia.

Mountains.—The mountains of Asia are numerous, distributed in vast clusters and long ranges, generally fixed on plains greatly elevated above the sea, in certain countries constantly covered with snow even in southern latitudes, and of course giving rise to many rivers, some of which are only inferior to one or two of the mighty waters to be found in the new continent. In respect of height, it was always imagined till lately, that none of the mountains in Asia equalled those of South America. A different opinion is now entertained; and it is supposed that this continent presents the greatest elevations on our globe. According to Colonel Crawford's observations, a peak of the Himala, or Snowy mountains, to the north of the British dominions in India, seen from Patna, is 20,000 feet higher than Nepaul, which is conceived to be 5000 feet above the sea; and still more recently, Mr Moorcroft has actually crossed these mountains, " whose height *has been found* to extend from 21,000 to 24,000 feet above the level of the plain out of which they spring."—*Quart. Review*, 1815.

The Altaian chain, one of the most considerable on the globe, running a course of nearly 5000 miles, may be considered as the northern face, or ridge, of the central region. The Uralian chain appears, at least in some maps, to arise from the westernmost branches of the Altaian, and to proceed thence almost due north towards the polar region, forming, as already mentioned, part of the western boundary of Asia. The Taurian chain, or mountains of Taurus, may be considered the counter-part of the Uralian, issuing from the western point of the central plain, and traversing the kingdom of Persia towards the south; but part of this chain, as we conceive it to be, under the well-known name of Caucasus, or Caucassian, in the largest sense, takes a northerly route, filling up much of the space between the Caspian and Black seas, and also sending off branches, under various names, towards the shores of the Mediterranean. The mountains of Thibet, which are entitled to be held as part of the southern front of the central range, appear to take a kind of circular direction, the concavity of which is turned towards the south. Smaller ridges are found traversing most of the Asiatic countries, especially in the vicinity of the sea-coast. The more striking detached hills or mountains of this continent are, Sinai and Horeb, in Arabia; the well-known mounts or hills of Palestine and Syria, alluded to in sacred scripture; Olympus, Rhea, and Ida, in Asia Minor; and Ararat, to the east of Armenia, but belonging to Persia.

Seas and Lakes.—Asia presents some remarkable collections of water detached from other seas, to which the name of lakes might be given, if their magnitude did not seem to require a more noble title. The chief of these is the Caspian sea, lying between Independent Tartary on the east, Persia on the south, the Turkish dominions on the west, and those of Russia on the north. It is about 700 miles long, from north to south, and between 100 and 200 miles broad from east to west, and is the receptacle of many important rivers. To the east, at the distance of about 100 miles, is another, but much smaller lake, denominated the sea of Aral, which by many writers, on tolerably good evidence, is imagined to have once been united with the Caspian. It is 200 miles long, nearly in the same direction, and about 70 broad, and also receives several rivers. Both of these seas consist of salt water, a circumstance in which they differ from the lakes or seas of Canada in North America. The lake of Baikal, near the middle of the southern part of Siberia, is a collection of fresh water, upwards of 300 miles in length, and not exceeding 35 in breadth. The central plain of Asia is supposed to contain several large lakes, but of these we have little information. Of those which are found elsewhere, and which are inferior to any now mentioned, it will be necessary to take notice in the accounts of individual countries.

Rivers.—The rivers of Asia are numerous, and often of great magnitude, corresponding with the height and extent of the mountains where they take their rise. The chief are the Kian-Ku and the Hoan-Ho, both rivers of China, and probably the largest in the world; the Ob, or Oby, the Yenisei, and the Lena, besides other very considerable rivers, all belonging to Asiatic Russia; the Amur, properly speaking a river of Chinese Tartary; the Ganges, Burrampooter, and Indus, of India; the Euphrates and Tigris. The origin of most of these and many other rivers, as might be expected, is to be found in the elevated lands which traverse the interior of this continent, from which they descend in all directions, as may readily be understood from the previous description of the central regions. On the whole, this continent is plentifully supplied with water, an advantage accruing from its peculiar conformation, and productive of some of the most essential benefits of which it can boast.

Climate, &c.—The climate and soil of Asia are extremely diversified. As but a small part of it is within the tropics, the heat is never so great as in some of the central countries of Africa. It would be difficult to find a single natural production in any other quarter of the globe, which cannot be paralleled in some part of Asia; and, on the other hand, it is to Asia, in a particular manner, that all the rest of the world looks for some of the chief luxuries and most desireable excitements of animal life. This remark may suffice instead of any enumeration of the various delightful objects in which it is so prolific.

Nor is it necessary to occupy any room in the zoology of Asia, which in fact is an epitome of the whole globe. A few different species are found indeed in America, and some varieties may be met with in the other two continents; but these exceptions are totally insignificant on the great scale to which we are now confining our attention. The same remark is equally applicable to the mineralogy of Asia.

Population, &c.—Asia is undoubtedly the birth place of mankind, and appears to have been specially adapted for that purpose. A more suitable spot could not be selected for the support and propagation of our species in an early stage of their existence, than is to be met with in some of its southern regions; and its extensive plains were no less proper for preserving many families together, till they had made such advancement in the knowledge of the necessary arts as would permit their separation with safety. But the ease with which nature produces her fruits, and the great abundance to be found in these regions, were not so well fitted for calling forth exertion and ingenuity on the part of man when he had attained a state of maturity. Some degree of difficulty is essential to his highest improvement. The chief excellencies of human intellect, indeed, are not the offspring of indulgence, though a plentiful supply of the necessaries of life be required for their developement. Here again, we may discover an appropriate adaptation of this continent to the state of our species beyond the period of infancy. It is connected with Europe and Africa in such a manner as to allow a ready transition, before mankind could be either able by their art, or prompted by their necessities, to trust themselves on any other element than the earth; and it is impossible to doubt that this circumstance, in its structure and relations, was really intended for the effect which we have every evidence for the belief was produced by it, the gradual extension of mankind over the rest of the earth. This is well illustrated by Dr Millar, in his "Philosophy of Modern History," to which we refer.

Linnæus, and other writers, have given tables of the varieties of the population exhibited in Asia. They are necessarily imperfect, as our acquaintance with many parts of this continent is still incomplete; but they have their use in the prosecution of history, as directing attention to the origin and relations of different nations. The amount of population has probably been over-rated at 500,000,000. But after making every reasonable allowance for exaggeration, particularly in the case of China, the number must be allowed to be a striking proof of the fertility and advantages of this continent. Without pretending to much accuracy, which is impracticable in this case, but in order to afford some general notions on the subject, we are induced to suppose the population of Asia and Australasia equal to a thousand parts, of the greater part of which our calculation furnishes us with the following proportional table.

Names of Countries.	No. of Parts
China	580
Hindoostan, in the largest sense, including from Cabul to Assam, and the island of Ceylon	170
Japan	60
Birman empire, including Siam, &c.	58
Persia	30
Asiatic Turkey, including Syria, &c.	26
Chinese Tartary, with Corea	18
Asiatic Russia	16
Arabia	14
Australasia	8
Cochin China, Tunquin, Laos, &c.	8
Independent Tartary	6
Malacca, with Sumatra	4
Thibet	2
	1000

Though drawn up with great pains, after a due consideration of many circumstances, this table cannot claim any other respect than as a mere attempt at approximation to the truth. The chief difficulty which it exhibits is the amazing proportion allotted to China, a country in reality of much less extent than what we have classified here as Hindoostan. Yet it is impossible, we believe, without very unwarrantable and very invidious surmises, to reduce the estimate. Admitting its correctness, then, we must either think less favourably than some of their advocates, of the manners, of the government, and the natural advantages of the Hindoos, or we must believe that the Chinese have discovered certain principles of policy still unknown to the greater part of mankind. The case of Japan, indeed, is very similar, nay, if any thing, more remarkable, as may easily be seen

Asia. by comparing the accounts of its extent with its alleged population. But the fact is, that of both these countries our information is so doubtful, and so contradictory, as to give rise to strange and discordant opinions.

Governments and State of Society, &c.—With some few exceptions, the whole of Asia may be said to be subjected to the despotic rule of a few individuals. Of a liberal government, not to speak of a republic, there is perhaps not an example to be found in the immense space between the Red sea and the Pacific ocean. So true it is, that by much the greater portion of mankind has never been redeemed from a state of slavery; for surely those must be called slaves who have neither rights nor property independent of the will of others, and whose lives and happiness are continually exposed to the fatal attacks of caprice and envy. Constitutional checks on power are utterly unknown in practice, and the semblance of them, in a few countries, must rather furnish an additional source of regret to those who have the smallest conception of their value. The only tried modes of avoiding the evils of tyranny are flattery and rebellion,—but flattery implies one of the worst evils, complete degradation of mind; and rebellion, again, only shifts the burden, or changes the sufferers, besides immediately producing some great miseries, which render the transition altogether a very doubtful relief. The established religions, in general, are no less unfriendly to the best interests of mankind, and serve still more effectually to perpetuate the weakness and barbarism of intellect which prevail. Superstitions of the most disgusting kind, and ceremonies from which common feeling, and common sense, recoil, supply the place of national doctrines and decent manners. But, in one respect, they are not unsuitable to the constitutions of the people, as they neither prompt to the exercise of the understanding, nor impose severe restraints on the inclination for sensual delights. Asia, therefore, presents few instances of highly cultivated faculties, and fewer of virtuous self-denial. But we should err if we imagined that intellect is altogether dormant, or that debauchery has grown to rankness in eastern countries. Some portion of mind is still required for the study and practice of the arts and sciences, limited as they are in kind, and scarcely advanced by one effort above the degree in which they existed several centuries ago, while the very nature of the climate retards the progress of licentiousness by enfeebling its powers. Rudeness and civility, pride and obsequiousness, simplicity and craft, are variously blended in the character of the people, forming a mass calculated to excite pity and contempt, rather than hatred or indignation, in the mind of an European. A charm is sometimes lent to it, by a vividness, or, more correctly speaking, a gaudiness of imagination, which displays itself in pompous expressions, and frequent allusions to the beauties of early poetry. Strangers are taken with this illusion; but it is soon properly referred to an early and irresistible acquaintance with the ornamental parts of nature, and has little or no connexion with the creative efforts of genius. Their works of taste partake of the same principle and rarely deserve any other praise than what is bestowed on happy imitations. The commercial transactions of the various countries are quite inconsiderable, and far from being conducted on the systematic principles, or prosecuted with the ardour of Europe. Very little of the sea-coast, which seems so favourable for it, is yet recognized in the annals of trade, and those parts which are most noted for advancement in this respect, have been indebted to the labours and zeal of persons who have gone in search of wealth from the western world. Altogether, the condition of mankind in Asia is more to be deplored than envied; and the disposition, the habits, and prejudices of the people being considered, together with the puny results of any experiments which have hitherto been made for its amelioration, there remains but small hope to the philanthropist, that it will be speedily or generally improved.

Progress of Discovery.—To the time of Ptolemy, or about the second century of the Christian era, the ancients appear not to have known more than a quarter of this continent. The reasons are easily explained;—many parts of it were uninhabited,—those which were most cultivated were far removed from the theatre of European concerns,—the science of discovery was in its infancy, or rather indeed had not commenced,—the spirit of commerce had not received aid from political motives,—navigation was confined to mere coasting voyages,—and travelling was dangerous, if not impracticable, beyond the limits of well organised society. The chief discoveries of the ancients were effected through the medium of war, and were rather incidental than the result of studied design and previous contemplation.

By the Egyptians.—Sesostris, one of the monarchs of Egypt, is said, at a very early period, to have led an army through a large portion of Asia, in which he established colonies. But the accounts of his life and operations are far from being entitled to implicit credit; nor do his alleged transactions in the east receive confirmation from the records of any of those countries which he is reported to have visited. The Egyptians, in general, were averse both to commerce and to intimacy with strangers. It may be well doubted, therefore, if the conquests of Sesostris, even admitting their truth, produced any important or permanent advantage.

By the Phœnicians.—The Phœnicians, a colony from Egypt, did not inherit the prejudices of their ancestors. They engaged extensively in commerce, which they carried on not only with various parts of Africa, and some of the coast countries of Europe, at this time scarcely emerged from the chaos of nature, but also with various places in the east. To this people, then, we may ascribe much of the information respecting Asia which existed in the ancient world, though the particulars of their progress are lost in the wreck of all their historical records.

By the Greeks.—The Greeks had commonly too much employment at home, during the most interesting periods of their history, to concern themselves greatly with the affairs of distant regions. Their philosophers, indeed, travelled abroad for the sake of improvement, but the result of their labours was favourable to almost any other science more than to geography. Herodotus the historian, who lived nearly five centuries before the Christian era, is with propriety considered as master of all the knowledge of it that existed in his day. He is, comparatively, copious on the subject of Asia; and, as far as can be ascertained, there does not appear to have been a great deal added to his observations, nor much corrections of his errors, up to the time of the Macedonian conqueror.

Under Alexander and his successors.—To the skilful and energetic undertakings of Alexander, must be ascribed a larger share of geographical discoveries in this continent than had been effected by all the philosophers and travellers that preceded him. Persia was laid open by his victories; the river Indus bore his fleet into the ocean, by which again it was carried through the Persian gulf to the Euphrates; India experienced alike the invincibility of his arms and the beneficence of his policy. His death, which occurred either too early or too late for his fame, did not altogether extinguish the light of discovery, though none of his successors had the talents or the judgment, or at least the good fortune, to profit much by his example. Seleucus, indeed, penetrated much beyond his progress, and sent one of his officers to Palibothra, on the Ganges, now probably for the first time seen by any European. But his advance farther to the east was prevented by the necessity of returning to defend his dominions, which had been threatened with invasion by Antigonus; and the subsequent prosecution of commerce, principally under the patronage of the Ptolemies, had scarcely any other effect on the science of geography than merely preserving the information that had been previously acquired.

The Greek princes of the kingdom of Bactria, originally subject to Seleucus, but ultimately become an independent state, appear to have maintained a commercial intercourse with India, and even to have extended their conquests in that country long after the death of Alexander. They assumed at one time the title of *Great King*, which, after every allowance for the exaggerations of vanity, argues, in some degree, the magnitude of their dominions as well as the supremacy of their power. During their continuance in this state of prosperity, it is highly probable that their countrymen towards the west would have many opportunities of cultivating an acquaintance with several parts of Asia, not only by their own observations in the course of their commercial pursuits, but also through the reports of such of the natives as were induced to form friendly and occasional alliances with them. Had this kingdom been prolonged, it is not to be doubted that Europeans would have earlier and more extensively contributed to the improvement of the geography of Asia. After an establishment of about 130 years, and nearly about the same space of time before the Christian era, it was completely overwhelmed by a horde of Tartars who had been driven from their native country on the confines of China, by a still more powerful body in their rear. Thus terminated the last fragment of the Macedonian conquests, and the door was shut for ages on European ambition and enterprise in these regions.

By the Arabians.—Ptolemy's work, which probably contained all the geography of his time, affords a very imperfect and highly erroneous delineation of Asia. But his mistakes, as well as his excellencies, were respected and copied, with little or no variation, for many centuries. The Arabians, indeed, under the impulse of a new faith, pursued both conquest and discovery in Asia, and, in several respects, advanced geography much beyond the prevalent notions. But their discoveries were either unknown to Europeans, or were disregarded, from an aversion to their religion, with the success of which they were perhaps imagined to be connected. It is only in modern times, accordingly, that justice has been done to the attainments of that singular people.

By the earlier moderns.—Cosmas, an Egyptian merchant in the reign of Justinian, made several voyages to India, of which he gives an account in his work entitled *Christian topography.* Together with a great deal of fanciful matter, this production contains some additional information respecting the west coast of India, apparently the result of careful and considerate observation. We learn from it, that in his time all the large ports of India were frequented by traders from Persia; and, which is a striking proof of the intercourse between these two countries, that in most of the cities of any note in India there were Christian churches established, the priests of which were ordained by the archbishop of Seleucia, the capital of the Persian empire, to whose jurisdiction they still continued subject. Alfred, king of England, in the 9th century, appears to have heard of the existence of these churches, and to have testified his regard for the common faith, as well as the interests of science, by the mission of Sighelm, afterwards made bishop of Shireburn, with presents to the shrine of St Thomas and St Bartholomew, on the Coromandel coast.

In the middle ages.—A taste for the luxuries of the east, which had survived the glory of the Roman empire, and even gained strength, notwithstanding the disasters of the times, urged the Italians, and some other people on the shores of the Mediterranean, to open a trade with Constantinople, and also to visit occasionally the ports of Syria and Egypt. In this latter case, the aversion of the parties to each other, on a religious account, was suspended or soothed by an experience of the mutual benefits arising from commercial intercourse. Important efforts might have been the consequence throughout the world, had the same good sense continued to operate. But the spirit of the crusades, which soon afterwards arose, and which for two centuries embittered the militant controvertists, gave a decisive check to this friendly understanding. The conquests of the Christians in Syria only increased their regret at the ultimate triumph of the Mahometan arms. Some partial light was communicated to geography during these impolitic expeditions. The encouragement afforded to the maritime states of the Mediterranean, the intercommunity established amongst the various countries of Europe, all engaged in the same cause, and the protection afforded from a conviction of their necessity and value to the interests of commerce, whenever they did not interfere with the primary objects of the enterprise, were still more substantial benefits. Nor ought we to omit mentioning the conquest of Constantinople by the Venetians and the chiefs of the fourth crusade, which took place in the commencement of the 13th century, as an event materially conducive to the preservation of an intercourse with the eastern regions. The great motive which led to this step, so inconsistent with the principles of the crusaders, and which afterwards influenced the Genoese to dispossess their rivals, was the desire of engrossing the trade with India, destined never to be lost sight of in the contentions and revolutions of Europe.

On the revival of letters.—The records of the 13th century allude to some other events directly conducive to the progress of Asiatic geography; among which are chiefly to be noted the missions of Pope Innocent IV. and St Louis IX. of France to the court of the emperor of the Moguls, a new and victorious power which had arisen in the heart of Asia, and the still more interesting travels of Marco Polo as far as to the frontiers of China. This remarkable person, by birth a Venetian, after having carried on trade for some time with several of the cities in Asia Minor, ventured to penetrate still farther into the east, and at last arrived at the court of the Great Khan, by whom he was favourably received, and employed in important services for many years. On his return to Venice, he published the account of his travels, which soon astonished all Europe, by a disclosure of mighty empires, and vast regions, far beyond the supposed boundary of the world. China is mentioned by him under the name of Cathay, by which it has been long known in the east. Having travelled through some of the provinces, he speaks particularly of several of its cities. Different parts of Hindostan are specified, and even sometimes by their present names, as Bengal and Guzzerat, both said to be opulent kingdoms. He visited many of the islands in the Indian ocean, besides the coast of Malabar, as far as the gulf of Cambay. This survey, the most extensive which had hitherto been made in these regions by any European, was proportionally important in its effects, though, in the peculiar circumstances of Europe, a considerable time was required for its full operation. The Venetians, in the meanwhile, enjoyed the advantages of superior commercial intercourse with the east, notwithstanding the attempts of the Genoese and other states to obtain a share.

By the Portuguese.—At no period did the prosperity of these republicans, as dependent on this trade, appear to be more firmly secured against successful rivalship than towards the end of the fifteenth century, when the discovery of a new course to India, by the Cape of Good Hope, effected by the Portuguese, occasioned its rapid and irrecoverable declension. This great event constituted an era in geography and in the history of mankind. Its immediate effect was an acquaintance with the coasts of Asia, vastly greater than had ever before been formed. The Portuguese speedily availed themselves of it to reach the countries of Cambodia and China, to possess the islands of the Indian archipelago, and to establish commercial colonies throughout a space of more than twelve thousand miles extent. The trifling discoveries made in the preceding century, by the travels of Oderico, a Venetian friar, Sir John Mandeville, an Englishman, and others, are totally unworthy of regard in the view of this splendid achievement.

By other Europeans.—For about a century, the Portuguese enjoyed the commercial sovereignty of the east, uninterrupted by the interference of any European. At last, the Dutch, having conquered their freedom from the tyranny of Spain, and making strenuous efforts for national consequence, appeared as their rivals. To them succeeded the English, with a rapidity which nothing could withstand, and with a success which still continues to enhance the dominions and the power of Britain. Since this period the geography of Asia has rapidly improved; but it is still imperfect, especially as to the central and northern regions. We cannot better indicate the amount or nature of the modern acquisitions than by specifying a few of the most valuable accounts of modern travels in its various regions. This we shall do much in the order of a French work, little known in our country, but to which one of our most popular geographers has been more extensively indebted than he has had the candour to acknowledge. It is entitled "Bibliothéque Universelle des Voyages, &c. par G. Boucher de la Richarderie." Paris, 1808, in 6 vols. 8vo. Our notices, which are select, may assist the studious reader in directing his attention to some of the best sources of information; but we are far from purposing to give a catalogue of titles more calculated to disgust the eye and exhaust the patience, than to convey instruction or save labour.

A List of Works proper to be consulted on the subject of Asia, arranged according to the geographical position of its various regions.

1. Asiatic Turkey, comprehending Syria, Palestine, some of the Mediterranean islands, &c.

Few works treat of the geography or natural history of these countries; most of them are occupied with antiquities, and researches into the opinions and customs of certain religious sects.

Dandini, a Jesuit, was sent by Pope Clement VIII. in 1586, to ascertain the creed of the Maronites, resident on Mount Libanus, who had for some time professed subjection to the Roman pontiff, but whose sentiments were held somewhat inconsistent with the Catholic faith. The account of his mission was published in the Italian language, in 1656, translated into French in 1675, and into English in 1698. La Roque, in a French work published in 1722, gives a much more judicious and interesting description of the same country and people. His remarks on the ruins of Heliopolis, or Balbek, though not without value, have been superseded by the labours of Wood and Dawkins, two English travellers, to whom also we are indebted for the best observations on the remains of the ancient city of Palmyra, printed at London in 1753. Some errors in their description are said to be pointed out by M. Cassas, in his *Voyage Pittoresque de la Syrie*, &c. published a few years ago at Paris, with a preliminary dissertation by Volney, whose own travels through Syria and Egypt, in the years 1783, 84, and 85, of which we have an English translation, deserve particularly to be recommended to the reader's attention. Browne, in his travels in Africa, Egypt, and Syria, from 1792 to 1798, adds some particulars, but

Asia.

not of much importance. Savary, Wittman, Olivier, Griffiths, and Clarke, in their travels, occasionally treat of the same countries. Pococke's Description of the East, &c., is invaluable to the antiquary. The accounts of Palestine are numerous, but, if we except Hasselquist, are very defective in the department of natural history. The "Views, &c. from the original drawings of Luigi Mayer," published at London in 1804, "with an historical and descriptive account of the country," are of great value. Russel's work on the Natural History of Aleppo, and parts adjacent, has long been esteemed for its fidelity and minuteness of description as to manners and customs, &c. Drummond's Travels, London 1754, treat particularly of the Isle of Cyprus; but we have a still more valuable description by Mariti, written originally in Italian, but translated into English under the title "Mariti's Travels through Cyprus, Syria, and Palestine." Some additional information is to be found in Sonnini's Travels in Greece and Turkey.

2. Arabia. For this country, consult Salmon's Modern History, Lond. 1739.; Clayton's Journal from Cairo to mount Sinai, &c. Lond. 1753; Niebuhr's Travels through Arabia, Lond. 1799; Rooke's Travels to the coast of Arabia Felix, &c. Lond. 1783; Lord Valentia's Travels, &c. Niebuhr edited a work on the zoology of this country, after the death of its author, Forskal. It was printed at Copenhagen in Latin, under the title, "Descriptiones animalium, avium, &c. &c. in itinere Orientali observatorum."

3. Persia, including Armenia, Mingrelia, and Georgia, provinces to the north of that kingdom, under Turkish government.

The earliest work we shall notice is a Collection of Voyages and Travels in Persia, by Chardin, Lond. 1772. This is merely an extract, and is long subsequent to some French edition of Sir John Chardin's Travels, which have long and deservedly been esteemed, though the descriptions do not exactly correspond with present appearances, as ascertained by more modern observers. It is extraordinary that the great excellencies of this traveller have not prompted a competent person to give a better form to his work in our language than we now possess. Mr Harmer, author of Observations on various passages of Scripture, was favoured with the use of the MSS. of Sir John Chardin, by Sir Philip Musgrave, one of his descendants, to whom they were returned. But it does not appear that any farther advantage has been taken of them than what was requisite for Harmer's purpose. The works of Le Brun, Thevenot, Tavernier, and Hanway, may be occasionally consulted. Some information is given in Ives's Voyage from England to India in 1754, &c. Lond. 1773; Franklin's Observations made on a tour from Bengal to Persia, &c. Lond. 1790; and Forster's Journey from Bengal to England, &c. Lond. 1790 and 1798. The most recent accounts of this kingdom, &c. are Olivier's Travels in the Ottoman Empire, &c. Waring's Tour to Shiraz, Morier's Travels, Kinneir's Geographical Memoir of Persia.

4. India in general, and some of the countries in particular. We shall select a very few out of the immense number of works allotted to this portion of Asia, confining ourselves to recent times.

Grose's Travels to the East Indies, printed several times in London since 1759; Dow's History of Hindostan; Maurice's Modern History, &c.; Rennel's Memoir of a Map of Hindostan, Lond. 1788, &c. This is a work of great merit, and demands the attention of the geographer; Forrest's Voyage from Calcutta to the Bay of Bengal, &c. Lond. 1792, is of value as to hydrography; Hodge's Travels in India, Lond. 1793, give some good views of remarkable places; Campbell's Overland Journey to India, Lond. 1795; and Taylor's Travels from England to India, &c. in the year 1798, will be found instructive.

An Historical Account of the Settlement and Possession of Bombay by the English East India Company, Lond. 1781; Historical Fragments of the Mogul Empire, &c. Lond. 1782; Warren Hasting's Review and Memoirs of the State of Bengal, &c. Lond. 1784 and 86; Major Symes's Account of an Embassy to the Kingdom of Ava, in 1795, is extremely interesting; Barrow's Voyage to Cochin-China, &c. Lond. 1806; Dr Tennant's Indian Recreations; Forbes's Oriental Memoirs; the Asiatic Register, and Asiatic Researches; Turner's Account of Thibet; Kirkpatrick's Account of the Kingdom of Nepaul; Elphinstone's Account of the Kingdom of Cabul; Malcolm's Sketch of the Sikhs; Tytler's Considerations on India; Buchanan's Christian Researches; Hamilton's East India Gazetteer; all have strong claims to attention in the various topics to which they relate.

5. Indian Isles, &c. Percival's Account of Ceylon; Marsden's Account of Sumatra; Stavorinus's Voyage; Forrest's Voyage; Thunberg's Travels, Lond. 1794; Kæmpfer's History of Japan, translated into English, Lond. 1728; Oriental Navigator, Lond. 1801; Krusenstern's Voyage.

6. China, Corea, &c. Du Halde's General History, Lond. 1741; the Accounts of Lord Macartney's Embassy, particularly Sir George Staunton's Work, and Barrow's Travels; De Guignes's Voyages a Peking, &c. Paris 1805, has been highly commended.

7. Siberia, Kamtschatka, &c. or Asiatic Russia.

Voyage en Siberie, &c. par M. Gmelin en 1743; Pallas's Travels, translated into English; Clarke's Travels. For Kamtschatka, see last volume of Cook's last Voyage, and the works there referred to; also Coxe's Account of the Russian Discoveries.

ASILUS, THE HORNET FLY, a genus of insects, belonging to the order Diptera.

ASP, a species of serpent, arranged under the Linnæan genus *Coluber*, and which is supposed to be extremely poisonous. The indistinct characters which are applied to the asp, and the vague details which have been given of its dreadful effects, render it difficult to determine to what particular species they ought to be referred. But it can scarcely be doubted that the whole history of the asp, from the time of Cleopatra, who, weary of the world, exposed herself to the bite of this animal, to put an end to her miseries and her life, to the present day, is interwoven with the fabulous creation of credulity and ignorance; and nothing can afford a better proof of the advantages of precise definitions and accurate classification. The assertion that the poison of the asp produced death without pain, is too improbable to admit of a moment's belief.

ASPALATHUS, African Broom, a genus of plants belonging to the Diadelphia class. *Aspalathus Canariense* is supposed to be the species well known by the name of *Lignum Rhodium*, or Rosewood, from which the rich perfume called oil of Rhodium is obtained, as it is generally supposed, by distillation, although it may be doubted whether that singular and high-priced substance be really the product of that process.

ASPARAGUS, Sparrowgrass, or Sparagus, a species of plants belonging to the Hexandria class, of which the common asparagus is well known, and much cultivated on account of its shoots, which furnish the table with a rich delicacy.

ASPERIFOLIÆ, or Asperifoliate Plants, denoting such as have rough leaves, is one of the orders of the natural method of classification proposed by Linnæus. *Pulmonaria*, or lungwort, and *borago*, or borage, are examples of plants which come under this order.

ASPERUGO, Small Wild Bugloss, a genus of plants belonging to the Pentandria class.

ASPHALTITES, a lake of Palestine, which has been distinguished by various names, and described with much marvellous detail. The bitumen called asphaltum, which is a production of its shores or waters, is the origin of one of its names. From its situation and relative position it is called the *East sea*, the *sea of the Desart*, and *sea of the Plain*; the *sea of Sodom*, because it occupies the place of the three cities which perished for the wickedness of their inhabitants, with those of Sodom and Gomorrah; and the *Salt sea*, from its saline impregnation. These names are mentioned in Scripture. It is also denominated the *Dead sea*, from the notion which long prevailed that no animal could live in its waters, and that birds flying over it were suffocated by its exhalations, and dropped down dead. The more accurate observations of later travellers, and the analysis of its waters by the aid of modern chemistry, have furnished materials for its true history. The extent is indeed yet undetermined. It is variously described as 50, 60, and 100 miles long, and from 7 miles to 25 miles in breadth. The waters are quite transparent, and have a bitter and saline taste. The strong impregnation with earthy and alkaline salts adds greatly to their specific gravity, and accounts for the difficulty of immersion which those who have bathed in the lake experienced. Chateaubriand, a late French traveller, found it inhabited by numerous fishes, and swallows skim its surface unhurt in pursuit of insects. Mr Gordon, a Scottish traveller, took up a quantity of the water, and submitted it to the examination of Dr Marcet of London, who found its specific gravity to be 1.211; and 100 grains contained of muriate of lime 3.920, muriate of magnesia 10.246, muriate of soda 10.360, and sulphate of lime 0.054, the whole of which is nearly equal to one-fourth of the weight of the water in solid contents. The bituminous matter which is found floating on the surface of the lake probably derives its origin from the decomposition of mineral matters at the bottom, or some parts of its margin.

ASPHALTUM, or Jews pitch, an inflammable mineral substance which is found on the waters of the Dead sea in Palestine, and far more abundantly in the extensive *Tar lake* in the island of Trinidad in the West Indies. Se Mineralogy.

ASPHODELUS, Asphodel, or King's Spear, a genus of plants belonging to the Hexandria class.

ASPLENIUM, Ceterach, a genus of plants belonging to the Cryptogamia class.

ASS, a species of Equus. See Mammalia.

ASSAM, a country of Asia, which is bounded on the north by Thibet, on the west by Hindostan, and on the east by part of the Birman empire. All the vegetable productions of the warmer climates are abundant in this region; the soil in many places is strongly impregnated with nitre, of which, it is said, gunpowder is manufactured by the inhabitants; some gold is collected by washing the sand of the rivers; and some silver, lead, and iron are extracted from their ores. The natives of Assam are represented as almost entirely destitute of every moral and religious principle; but they possess a bold, fearless, and enterprising courage, which has enabled them to resist the most powerful attacks, and to preserve their independence.

ASSASSIN, a person who secretly puts another to death. The word is derived from the Arabic, which signifies *to kill*; and in the vulgar Arabic it denotes robbers in the night, or persons who lie in ambush to kill.

ASSASSINS, a tribe or race of people who occupied different regions in Persia and Syria, and were subject to a chief designated *the Old Man of the Mountain*, whose power was absolute. This race of people seems to have been actuated by the mixed influence of warlike and religious principles, combined with a barbarous heroism in the performance of deeds of the boldest enterprise. It is probable, too, that the chief of this ferocious banditti was employed by some of the powers of Europe as a horrid political instrument to execute vengeance on their hostile rivals, when open attack and ordinary warfare were unsuccessful; for when a victim was marked out for their revenge, a party was secretly dispatched to the place of his residence; with unceasing vigilance they observed all his motions; with unrelenting perseverance they pursued his steps, till a certain opportunity offered of inflicting the direful blow on his devoted head. For a period of 160 years these assassins continued to be the terror of Europe. Their numbers at one time was estimated at 40,000; and they were reduced and exterminated by the Mamelukes in the year 1280. See Hume's *Hist. of England*, and Gibbon's *Rom. History*.

ASSAULT is a law term which signifies an injury offered to a man's person. It has been defined an unlawful setting upon one's person, as when one person lifts his cane or fist in a threatening manner to another, or strikes at, but misses him. But what is termed assault and battery is constituted by an actual beating. See Blackstone's *Commentaries*.

ASSAYING is a process which is usually restricted to the examination of alloys of gold and silver, to ascertain the quantity of precious metal in the compound. See METALLURGY.

ASSER, JOHN, one of the earliest historians of Britain, is supposed to have been a native of Wales, assumed the monastic habit, and, on account of his learning, was warmly patronized by Alfred the Great. Several literary productions are ascribed, on doubtful authority, to Asser; but the *Annals* of the Life of Alfred, published by Parker in 1574, of which the latest edition was printed at Oxford in 1723, are supposed to be genuine. Through the influence of the learned Asser with the king, it is said that Alfred restored the university of Oxford.

ASSESSOR, is applied to a person who sits along with the judges in the inferior courts in Scotland, and with his professional knowledge assists in the decisions pronounced. Assessors are generally selected from the Faculty of Advocates.

ASSETS, an English law term which denotes the effects sufficient to discharge the burden which falls upon the heir or executor, in satisfying the debts and legacies of the testator or ancestor. Assets are either real or personal; to the first belong all lands which descend to the heir; and the personal estate or effects which go to executors are assets *personal*. See Blackstone's *Commentaries*.

ASSIGN, in the common law of England, signifies to make over a right to another, or appoint a deputy; but in a more restricted sense it signifies to set forth or point out, as to assign error, false judgement, &c.

ASSIGNATION, in the law of Scotland, denotes a deed of conveyance, by which the property of any subject which is not strictly feudal is transferred from one person to another. See Bell's *Dictionary of the Law of Scotland*.

ASSISE, from the French word *seated* or *established*, is a term of various signification in the law proceedings and domestic policy of this country: as the sittings of court; the regulations or ordinances of a court; a jury, because it sits till the verdict is pronounced; and the regulations of weights and measures, or prices of certain things, as the *assise* of bread.

ASSITHMENT, or ASSYTHMENT, a term in the law of Scotland, denoting a compensation, or *weregild*, by a pecuniary fine, which is due to the heirs of a person murdered by the person who is charged with the crime, and who pleads a remission.

ASSOCIATION *of ideas*, a phrase employed by logicians and metaphysicians, to denote that succession of thoughts which arise in the mind in consequence of some natural relation or accidental coincidence by which one idea or thought is called up by another in the mind, without any seeming exertion. Thus the scenes of early youth seldom fail to excite pleasing emotions; the occurrence of any of the incidents that accompanied a severe disaster, presents it to the recollection; the resemblance of a stranger in features, manners, or dress, recals the image of a distant friend; and this again by a new association, brings with it a train of agreeable reflections on his kindness, disinterestedness, or generosity. See LOGIC and METAPHYSICS.

ASSOCIATION, AFRICAN. See INSTITUTION.

ASSUMPSIT, is a term in the law of England which denotes a voluntary covenant or verbal promise, by which one person undertakes to perform or pay something to another. An assumpsit is either *express* or *implied*; *express*, when a positive and distinct agreement has been entered into; and *implied* where it may be fairly presumed, from the nature of the transaction, that such agreement was intended, or, according to the principles of equity, ought to have been made. See Blackstone's *Commentaries*.

ASSUMPTION, the capital of the province of Paraguay, in South America, stands on the eastern bank of the river Paraguay, and about 150 miles above the junction of that river with the Parana. It enjoys an agreeable climate, and the fertile soil of the surrounding country produces wheat, maize, sugar, tobacco, and cotton. The population exceeds 7000. The town can boast of little elegance; but it contains a cathedral, several churches, a college, and some convents.

ASSURANCE. See INSURANCE.

ASSYRIA, an ancient kingdom of Asia, which, it is supposed, comprehended the provinces of Diarbekir, Curdistan, and Irac. According to the older geographers, it was bounded on the north by Armenia, on the west by the Tigris, and on the east by Media. But its geographical limits are indistinctly known, and its civil history is involved in equal obscurity. Some notices of the kingdom of Assyria are recorded in sacred Scripture; and for an account of the conjectures of historians concerning it, see Rollin's *Ancient History*.

ASTARTE, and ASTAROTH, a Syrian or Phœnician goddess, called in Scripture the *Queen of Heaven*, and it is supposed is a divinity analogous to the Venus of the Greeks and Romans, the Mithra of the Persians, and the Isis of the Egyptians. Splendid temples were erected in honour of this goddess, and a train of three or four hundred priests was constantly occupied in offering sacrifices and oblations.

ASTER, STAR-WORT, a genus of plants belonging to the Syngenesia class, several species of which are well known ornaments in the flower-garden.

ASTERIAS, STAR-FISH, a genus of vermes belonging to the order *Mollusca*. See HELMINTHOLOGY.

ASTI, a city of Italy, finely situated in a valley on the banks of the Tanaro, adorned with an elegant cathedral, some fine churches, and many splendid public edifices, and including a population of more than 21,000. The surrounding territory is celebrated for its excellent wines.

ASTORGA, a city of the kingdom of Leon in Spain, which is surrounded with walls supposed to have been the work of the Romans. The population is estimated at 4000; and the distance from Madrid is about 150 miles.

ASTRACAN, an extensive province or viceroyalty of Russia, is bounded on the north by Bulgaria, on the south by the Caspian sea, on the west by the river Volga, and by a mountainous region on the east; and extends from the 46th to the 52d degree of north latitude. The summers are often extremely sultry, but the winters are sometimes very severe.

Wide tracts of this province are covered with saline marshes; but in many places the soil is fertile and produces a luxuriant vegetation, and some of the most delicious fruits. The vine thrives well; cotton is successfully cultivated, and the silk-worm is productive. The rivers abound with fish; and the fisheries are some of the chief sources of the wealth of the province. The manufactures of common salt, nitre, and leather, are extensive. Isinglass is prepared from the sounds or palates of the sturgeon and beluga; and caviare, which is transported to every part of Europe, is the salted roe of the same fish. The locusts are sometimes exceedingly destructive in this province.

ASTRACAN, the capital of the province of the same name in the Asiatic part of the Russian empire, stands on the banks of the Volga, which is three miles broad, and is the principal seat of the commerce of Russia in the east. A dockyard and naval storehouses have been established by the government to facilitate trade. The houses were formerly of wood, which rendered them liable to destructive fires; but stone and brick buildings are now more common. The population of Astracan is stated at 20,000; but the great resort of strangers from all parts of the world on commercial concerns, increases that number threefold. The established form of religion is that of the Greek church; but places of worship belonging to every sect and country are seen in the city. The central situation of Astracan commands a very extensive commerce, a large share of which is in the hands of Armenians.

ASTRAGAL, the moulding which separates the shaft of a column from the capital. See ARCHITECTURE.

ASTRAGALUS, Milk-vetch, or Liquorice-vetch, a genus of plants belonging to the Diadelphia class.

ASTRANTIA, Master-Wort, a genus of plants belonging to the Pentandria class.

ASTROLABE, an instrument employed by the ancients for making astronomical observations. This instrument resembled the armillary sphere. The same name is applied to other instruments for similar purposes, and particularly to one which was used for taking the altitude of the sun and stars at sea.

ASTROLOGY, a term originally and long synonymous with Astronomy, is now restricted to an imaginary and fictitious science, by which the future fortunes of individuals are supposed to be ascertained in the appearances, relations, and connexions of the heavenly bodies. It is a kind of divination which seems to have been practised seriously or fraudulently in the early stages of all nations; but the increase of knowledge, consequent on the improvement of social life, universally discloses its futility, and the revelation of the divine will supersedes its pretensions, and condemns its exercise. Wherever civilization, therefore, has attained stability, independent of the aid which superstition offers to the science of government; and wherever the Scriptures are freely allowed to modify public opinion, this delusive system is treated with contempt, and the influence and splendour which it may formerly have enjoyed are remembered with feelings of mortification and regret for the stupidity and weakness of mankind.

But unworthy and disgusting as it may be, the history of Astrology is a proper subject for philosophical investigation. Opinions so widely spread, and so strongly operative as those on which there is every reason to believe it was built must be deeply rooted in human nature. Their progress, supremacy, and decline, are intimately connected with the varying condition of our species.

What could give rise to the notion, that those immensely distant bodies which stud the firmament, and the inhabitants of this lower world, are so related, as that changes in the former are productive of, and foretel the vicissitudes of the latter? Different answers may be given to this curious question, but perhaps few of them deserve implicit, certainly none of them can demand exclusive credit. Probability is all that seems attainable in the discussion.

The coincidence of some remarkable event with an observed peculiarity in the arrangement of the celestial bodies, may have suggested the notion of their relationship. Several simultaneous occurrences of the kind would confirm it; for it may safely be asserted, that constancy of conjunction is one of the most imperative elements of natural logic. There are familiar examples in the universal reference of the transitions of day and night, and the returns of the seasons, not to mention the various kinds of weather, to the position of these bodies.

Again, the conviction, which is so congenial to our nature, and is so readily excited by the untoward circumstances of life, that there exists a power superior to human will and intelligence, may have been early coupled with the notion, that the heavenly bodies, especially the sun and moon, were the place of its residence, if not entitled, as was sometimes imagined, to the highest adoration. Hence would result the belief of the expediency and advantage of consulting their manifestations, as the primary causes and arbiters of all temporal concerns. In other words, this system may have originated in the conceits and absurdities of mythology, which again, it is probable, may be traced to the corruption of true religion.

A more refined sentiment, founded on the pride of man, and perhaps deducible also from a vitiated commentary on some divine revelation, might have held the elements of nature and the whole constitution of the heavens to be subservient to the necessities and comforts of our race, and therefore as well calculated to relieve anxiety for the future, as to minister to present demands. To this darling principle the stars might seem to share with some other things the office of pre-indicating events, and only from their greater dignity to be deserving of most attention. But this admission did not hold universally, as is evident from the preference given by some people to the entrails of animals, the flight of birds, the various kinds of oracles, &c.

Something similar to this last mentioned notion, is the belief, which is easily defended on a principle of piety, and therefore which was likely to be entertained wherever religion had a semblance of rationality, that the heavens and the earth being the creation of a beneficent and skilful architect, were in harmony with each other, and mutually indicated the revolutions which they were destined to undergo.

Astrology.

Of these, and it is believed all other solutions of the question yet suggested, it is obviously just to remark, that they rather point out the nature of the tendency to this system which exists in the human mind, than assign the grounds on which its peculiar principles and technical rules have been built. These it is impossible to explain, without entering more fully on the minutiæ of the pretended science than its importance demands, or the condition of physical and moral knowledge seems to require. Astrology appears to have found a favourable soil in the constitutions of Englishmen, as is pretty well proved by the number of treatises on the art which were published in the language, especially during the reign of queen Elizabeth. A complete catalogue of these works, with adequate notices of contents, is a desideratum, and merits the labour of one of our industrious antiquaries. The books themselves are never to be met with now, except in the libraries of collectors,—so much for the intelligence of our times. Several of them are mentioned by Sir Egerton Brydges, in his Censura Literaria and British Bibliographer. Moore's Almanack, the only *current* relic, it is believed, of a host of worthies, which used

> To deal in destiny's dark counsel,
> And sage opinions of the moon sell,

probably derives all its power of circulation from the sagacious adaptation of the kalendar, and other useful tables, to the stinted finances of the vulgar. The very general condemnation, it is thought proper to mention before concluding, of the *doubtful* sanction to the pretensions of the astrologer that is given in a recent novel, may be properly adduced as an evidence of modern incredulity. The sense of its absurdity must be powerful, indeed, which could reprobate a machinery, to use the language of criticism, defensible on the ground of poetic licence, and the source of such diversified excellencies and interest.

Astronium.

ASTRONIUM, a genus of plants belonging to the class Diœcia.

ASTRONOMY.

Definition.

ASTRONOMY is that branch of natural philosophy which treats of the heavenly bodies, and whose object is to discover the general laws which regulate their various changes.

The striking appearances of the heavenly bodies; the remarkable measures of time which they afford; the importance of a correct knowledge of their motions to the purposes of the arts; the scale also of these motions, which admits of their being estimated and expressed in sensible quantities, as lines and numbers, and thus allows us for the discovery of their laws the powerful aid of mathematical research, joined to the immense resources of art; all these causes have concurred in making Astronomy the oldest and most perfect of the sciences.

Arrangement.

In treating this subject, we shall, in Part I. consider the phenomena as they appear to the naked eye, and as every one can easily observe them. Having shewn how little information, concerning the system of the world, can be derived from this source, we shall in Part II. shortly explain the principles upon which more precise observations are made, and the results of these observations to the present time.

PART I. PHENOMENA OF THE HEAVENS AS THEY APPEAR TO THE NAKED EYE.

CHAP. I. OF THE PHENOMENA OF THE HEAVENS AND EARTH.

SECT. I. *Of the Diurnal Motion.*

Our notions of the phenomena of nature, which at first are always vague and indefinite, gradually improve as we continue our observations and reflections. The heavens and earth seem at first sight to form the two grand divisions of the universe—the earth a vast surface composed of sea and land, extending all around us; the heavens or the sky an immense roof or curtain, resting upon the earth at the extremity of our prospect, and extending over our heads.

The clouds which occasionally obscure this blue concavity, are often observed between us and terrestrial objects; we conclude that they cannot be far off, and belong rather to the earth than to the heavens: Our attention, however, is strongly attracted by the singular objects, the sun, the moon, and stars, which seem attached to the sky at a much greater distance, and which by considering them attentively we discover to be continually in motion.

The Sun.—The sun, by far the most striking object, is observed in the morning to *rise* out of the ocean, or from behind the most distant mountains—to traverse the sky at a considerable elevation,—and finally in the evening to disappear or *set* in the opposite quarter from which he rose, producing by this arrangement the vicissitudes of day and night. That quarter of the heavens in which he rises is called the *east*, the opposite quarter where he sets the *west*, and that line along the sea and land which seems to bound our prospect, and beyond which the sun seems to retire during the night, is called *the horizon.*

The Moon.—The moon, apparently equal to the sun in magnitude, though far inferior in splendour, follows the same course.

The Stars.—The stars have hardly any apparent magnitude; they shine like brilliant points in the sky, but their singular beauty, in a fine winter's evening, every one must have remarked with admiration. One curious circumstance regarding them, and of

Phenomena of the heavens, &c.

a character quite different from the setting of the sun and moon, is their gradual disappearance in the morning, before the approach of the sun. To discover the cause of this, observe the heavens a little after sun-set; the stars in the west are scarcely visible, while those in the east are shining with all their lustre. The same happens in a reverse order at the dawn of day; the stars in the east shine feebly, but those in the west exhibit nearly their usual brightness. It is natural to conclude that those luminous points are spread over the whole surface of the sky, and are only concealed from us during the day by the more dazzling light of the sun, and this conjecture has been verified by more precise observations.

So numerous and extensive a collection of moving objects, seems to present an ample field for such observations as may conduct us to a theory of the universe. We find, however, that, with a very few exceptions, a single motion appears to pervade the whole system. While these objects retain invariably the same positions relatively to each other, exhibiting constantly the same figures and the same groups which have even been recognised and designated from the remotest antiquity, and from which circumstance they have been termed the *fixed* stars,—while, in relation to each other, they thus exhibit every symptom of complete repose, we find that they have all a motion, whose direction a spectator can easily observe, if, on a clear night he take up some conspicuous position; and suppose he stands with the east on his left, and the west of course on his right, he will then have before him the *south*, and behind him the *north*, he will soon become sensible of the general motion. The stars in the west will be observed gradually to approach the horizon, and finally disappear, while new ones have, in the mean time, appeared above the horizon in the east; if, about the time of sun-set, he remarks some star in the east, near the point where the sun rose in the morning, he will see it follow in the very same course, rising to the same elevation in the sky, and approaching to the same point of the horizon in the west. The stars which rise farther before him in the east, or farther towards the south, will be observed to set farther before him on the west, and to mount to a less considerable elevation, exactly as the points of their rising and setting approach towards the south, or to the point directly before him. In fine, he will observe stars in the south which just graze the horizon, rising and setting in a very little time, and nearly at the same point.

If he now turn to the north, an arrangement somewhat analogous, but at the same time considerably different, will be remarked. Those stars which rise farther before him on the east, set also, as before, farther before him on the west, but they rise to a *greater* elevation in the sky. Some stars towards the north are observed to set, and almost immediately to reappear nearly at the same point of the horizon; but the most remarkable circumstance is, that some stars, as those of the constellation of the Great Bear, or the Plough, never set at all, but are visible during the whole of the night; and that there is a point considerably elevated above the horizon, where the stars seem in perfect repose, and round which the former, as they are observed sometimes above, sometimes below, sometimes east, and sometimes west, but always at the same distance from it, round which, therefore, they seem to describe circles larger and larger as their distance from it increases. In short, all these appearances are exactly what would happen, by supposing the whole heavenly bodies attached to the surface of an immense sphere, quite unconnected with the earth, but of which the earth occupies the centre, and revolving upon two fixed points diametrically opposite to each other, of which the one is that point considerably elevated above the horizon, where the stars are observed in repose, and the other is concealed from us by the horizon being equally depressed below it. Thus, let P H p O, Plate 21. Fig. 1. represent a globe or sphere turning upon two points, P, p; or join P p, turning upon an axis, P A p, and let the lines, *a b c*, *a b c*, &c. (which are conceived to rise above the paper, from *a* and *c* to the centre *b*) represent the circles which the points, *a a*, &c. describe, by revolving always at the same distance round the axis P p, increasing in magnitude as they recede from the stationary points, P, p. Let a spectator now on the earth at the centre A, and whose horizon is H A O, view the stars in the hemisphere H P O revolving in the direction E A Q, H will be the south point of the horizon, and O the north, P will be the point where the stars seem at rest, and round which they seem to circulate in larger and larger orbs, *a b c*, 1 b 2, &c. as they are situated farther and farther from it. At the point c, in the circle 1 b 2, the stars will be observed to set, and in a very little time to reappear nearly at the same point; at the point H, they will just seem to graze the horizon; and in proportion as their points of rising and setting, *e*, *f*, &c. are situated farther and farther from H, they will rise to a greater elevation H g, H r.

It is natural to conclude, from all these appearances, that, could we see below the horizon, the stars would appear to move in a manner perfectly similar to what we remark above; and that another pivot would there be observed, round which their revolutions would seem to be performed.

Horizon.—What, then, is the nature of the horizon, which hides so many objects from our view? The answer to this question may perhaps be obtained, by changing our situation on the earth, in the same manner as we find the distance of remote objects by viewing them from different positions. We shall thus see what becomes of the apparent barrier of our prospect, by continually advancing towards it. The aspect both of the heavens and earth is accordingly observed to change continually as we change our point of view. On the earth we lose sight of some countries and discover others; by advancing towards the south, we discover, on looking to the south, stars, just appearing above the horizon, which had not formerly been observed, while those that formerly grazed the horizon are now observed to rise more and more above it, as we continue to advance more and more to the south. On looking again to those stars in the north, which had formerly never set, but which, in the inferior part of their course, came very near the horizon, we find that they now disappear for a short time;

and reappear nearly at the same point, while those which we had formerly observed so short a time below the horizon, now continue invisible longer and longer as we advance to the south. It is apparent, then, that the horizon, instead of being a real limit, is receding from us on the one hand, and thus discovering to us new objects, while it is following us on the other, and hiding from us those objects which we had formerly observed. By advancing in this manner, the same appearances continue, till we at last discover a point in the southern sky where the stars seem again in complete repose, and whose existence our previous observations had indicated with considerable probability.

Celestial sphere.—The sky and the stars, then, are no where coincident with the earth, as we at first imagined; in fact, to whatever part of it we go, they seem always at the same distance from us; they seem, therefore, evidently to be arranged upon the surface of an immense sphere, of which we ourselves occupy the centre. This is called the *celestial sphere*; it is not a real object, it is merely a conception of the figure that would seem to arise from the junction of all the stars by some material substance.

We may consider it, therefore, as an established fact, that the system of the stars on the celestial sphere seems to revolve once every day round two fixed points. This motion is called the *diurnal motion* of the sphere or of the stars, and the fixed points are called the *poles* of the sphere; the one which we observe in this country is the North, the other the South Pole; and an imaginary line joining the two poles, is called the *axis* of the sphere.

Figure of the earth.—Let us now attend to the singular figure which these appearances should lead us to ascribe to the earth. The figure of the surface which in any case bounds our prospect, is always indicated by the manner in which new objects make their appearance as we change our situation. In a flat country, the view is much less varied than in one that is more irregular; in the one the traveller observes nearly the same objects from every part of it; in the other, where he sometimes descends into valleys, and sometimes ascends to considerable elevations, he is continually losing and regaining his view of the distant landscape. On attaining the summit of some great mountain, the whole country on the opposite side often bursts upon him at once, while in other cases it rises into view always the more gradually as the curvature of the mountain is less abrupt.

Its roundness.—Advancing upon the earth, then, on a much greater scale, since we are continually discovering new objects, its figure cannot be that of an immense plain, as we are at first so strongly tempted to imagine, while the regularity with which the stars in the north disappear as we advance to the south, and those in the south become visible, evidently indicates, upon the whole, notwithstanding its apparently immense irregularities, a degree of roundness, or regular curvature, in the direction of north and south, like that of a swelling eminence, on which the spectator, as he advances, gradually discovers the country before him, and loses sight of that which is behind. We thus appear to be in the situation of a person on the curved surface A B C D, Plate 21. Fig. 2. viewing the stars in the hemisphere H P O p, the surface being so immense, in respect to himself, that he can see but a very small portion of it all round him at a time; and that the line H A O, which touches it at the point where he stands, and therefore changes its direction along with him, forms nearly the boundary of his prospect all round, and prevents him from seeing more than one portion, HPO, of the sphere H p o at a time; when he arrives, therefore, at B, this horizon has assumed the position h B o, discovering to him the stars in the portion H h, and hiding those within O o. But this convexity of the earth, is far more strikingly manifested by observations on the smooth surface of the ocean. When navigators recede from the shore, they observe the edifices and mountains gradually sink, and finally disappear; while the vessel presents the same phenomena to the spectators on shore, gradually sinking, and, finally, like the setting sun, plunging into the ocean. This cannot be owing to the distance, which tends to make objects appear less, as a small object becomes invisible upon a distant mountain; for the mariner, by ascending to the top of the mast, sees distinctly those objects which had disappeared to him upon deck; while the vessel re-appears to a spectator on the shore as he mounts to a greater elevation.

Circumnavigation.—But the most decisive proof of the roundness of the earth, is its actual circumnavigation. This bold attempt was first made by Magellan. Setting out from one of the ports of Portugal, he advanced in a westerly direction, and, after a long voyage, arrived at the great continent of America, already discovered by preceding navigators. Unable now to continue his route towards the west, he sailed along the coast to its southern extremity, and passing the straits known by his name, found himself in an immense ocean, already known by the name of the South Sea. Resuming now his course westerly, Magellan arrived at the Molucca islands, where he lost his life; and his vessel, still proceeding westward, finally arrived at Europe, and entered, as if from the east, the port it had left for the west. This great experiment has been often repeated; and it clearly shews the earth to be convex from east to west, as we have already observed its roundness from north to south.

Antipodes.—It is curious, no doubt, to consider, that those who inhabit different parts of the earth have their heads turned different ways, as in Fig. 2.; and it might be at first imagined, that those who are opposite to us would fall off the earth on account of their own weight; but if weight be considered what it really is,—a tendency which all bodies have to descend in straight lines directed towards the centre of the earth, its direction must evidently vary like the spokes of a wheel; and the same force which attaches us to the earth, will, acting in an opposite direction, attach our *antipodes* to it in the same manner.

However strange, therefore, the conclusion is no less irresistible, that *the land and waters of our earth compose a mass round in every direction and insulated in space.* It has been found to exceed 8000 miles in diameter, or to be nearly 25,000 miles in circumference.

It is certainly difficult to conceive, how the earth, thus apparently unconnected, can support itself in the middle of space; for we naturally extend to the earth itself the property of weight, which we observe common to all the bodies on its surface. But admitting that the earth actually has a tendency to descend to some portion of space, it is not impossible for it to be at the same time endowed with a tendency, in another, perhaps an opposite direction, so as to remain suspended by the combined effect of the two forces, like a balloon, under the joint influence of gravity on the one hand, and its own buoyancy on the other; or there may be various ways in which nature might produce the same effect. As there is nothing, therefore, in the phenomenon of weight inconsistent with the earth's remaining suspended, instead of doubting, on this account, a fact which all our observations so remarkably confirm, astronomers have rather inquired the more diligently into its cause; and its developement has disclosed the true system of the world.

Sect. III. *Dimensions of the Celestial Sphere.*

Let us now endeavour to obtain some idea of the distance of the stars, or of the sphere whose centre we seem to occupy. This attempt, though at first it seem difficult, if not impracticable, is effected upon very simple principles. But there are two kinds of distance, which must never be confounded in astronomy, and of which, as it is very simple in itself, we shall here explain the distinction; the one is *linear*, the other *angular* distance.

Linear and angular distance.—Let there be a series of objects, A, B, C, D, Fig. 3. situated in the same line A B C D; they will mark out larger and larger portions of linear extent A B, A C, A D, &c.; and to a person at A, his distances from B C D, &c. always mean the lines A B, A C, A D, &c. But, viewed from the point *a*, the objects will mark out at the same time larger and larger *angles*, A *a* B, A *a* C, &c. and the distance of the two, A and B, relatively to a spectator at *a*, means their angular distance; it is the angle which the lines converging from the objects to the eye, or diverging from the eye to the objects; the angle or degree of opening or divergence which these lines, a A, a B form at the eye, or the direction of one of the objects relatively to the other.

The same will happen, if, instead of a series of objects, a single object be supposed to assume successively the positions B C D, &c.; and if a continued motion be ascribed to it in the line A B C D, it will then mark out every possible degree of linear extent, as it continues for ever to recede from the point A. To a spectator at *a*, however, it will by no means mark out all the degrees of angular magnitude; for at the greatest distance, suppose *n*, to which it can possibly arrive in the line A B C D, the angle A *a n*, however near it may approach, can never actually attain, far less exceed, the magnitude of the angle A *a y*; *a y* being the limiting direction to which the line *a* A, *a* B, *a n*, joining the object and the spectator, is continually approaching as the object recedes from A, but to which it can never actually arrive.

It is only when the object is supposed to change its direction, so as to revolve round the spectator, that it exhibits every variety of angular distance. The line A *a* will, in that case, revolve about its extremity, *a*, and will go on for ever to describe new portions of angular extent, reproducing, however, after a complete revolution, the very same series of changes in position; after revolving from A *a* to A *y*, and to A *a* again, it will just recommence the same course, occupying in succession the same identical situations *a* B, *a* C, *a* D, as well as all the intermediate points.

The whole circuit, then, becomes a fixed and very convenient standard for comparing one degree of divergence with another. Its fourth part is called a *right angle*. Thus, when the line a A, Fig. 4. having made a quarter of a revolution, comes into the position a B, the angle A a B is called a right angle; the lines a A, a B are said to be perpendicular to each other; or if they form the two sides of a solid body, A a B, Fig. 5. it is said to be *square* at the point a. When a A, Fig. 4. has described the next quarter revolution, being now in the position a C, directly opposite to its first position a A, and having thus described half a revolution, or two right angles, it then begins to approach its first position, though the angles reckoned in the same direction are still increasing. When it arrives at a D, it has described three right angles, or three quarters of a circuit, though it now only wants one from its first position. Any line, a Z, situated between a A and a B, diverges less from a A than a B, and any line, a Y, between a B and a C, more; A a Z is less than a right angle, it is an *acute* angle, and A a Y greater, it is an *obtuse* angle. See *Leslie's Geometry*.

Though there is, in reality, therefore, no difference in the manner in which an object changes its position, yet, relatively, to the position of a spectator, there thus arise two kinds of distance, which are exhibited, uncombined with each other, linear by a *progressive*, and angular distance by a *revolving* motion. These two sorts of distance are quite independent of each other; for as the distances A B, A C, AD, Fig. 3. of the progressive point would have been the same in any other line, A b c d,—as, in estimating its distance, it is of no consequence to a spectator at A, whether the point goes off towards the north, south, east, or west,—as the linear distances of objects are therefore no way affected by their direction, neither are their angular distances any way affected by their remoteness. Provided two objects be situated, the one on the line a B, Fig. 4. the other on the line a A, though the one be 10, 100, or 1000 miles farther from the point A than the other, their angular distance is still represented by the angle A a B; and on the other hand an object may shift to every point of the compass without ever changing its distance from the centre of motion.

But progressive motion becomes much sooner insensible to us as the object recedesto a distance than angular. We are often at a loss for some time to determine whether a vessel, far out at sea, is advancing, stationary, or retiring; while another, at the same distance, and having really no greater velocity, is making a sensible progress to the right or left. It is thus with the heavenly bodies; their distances from us are so great, that their progressive motions, if they have any, are to the naked eye altogether in-

Phenomena of the heavens, &c.

sensible, while their angular or revolving motions are obvious to the most careless observer; hence it is to the latter that we look, in the first instance, for any information as to the system of the world; and hence the term distance in astronomy refers much more frequently to angular than to linear distance.

Measurement of distance.—When objects are near us, we form, at a glance, a pretty correct estimate of their distance; but this rapidity of conception arises from experience, aided by the wonderful power of habit. It is well known, that when a person, blind from his infancy, suddenly acquires the use of his sight, he has no idea whatever either of the position or the figure of surrounding objects, either of their angular or linear distance. He has got possession of a new and very powerful instrument, but is utterly at a loss how to manage it. His ideas seem to be all formed upon the scale of his sense of feeling. In the case of a young man, couched by Cheselden, all objects, it is said, seemed to touch his eyes as they had formerly affected him by touching his skin; he still was unable, by his sight alone, to distinguish a round from a square body; in short all seemed confusion and perplexity before him, and it was only by continually comparing the impressions of his feeling with those of his sight, that he was trained to the use of his new sense.

Even with those, therefore, whose vision is perfect, as might be expected, this faculty of distinguishing distance at sight declines rapidly, as we lose the power of measuring the impressions of the one sense by those of the other, either when the objects become more and more remote, or when fewer of them intervene, whose distances can be compared with the extreme one. It is on this account that we are so much less sensible of distance at sea, where there are few intervening objects, than at land, where there are houses, trees, and a variety of objects whose distances can be compared with each other, and with the remote one. It is thus also that the heavenly bodies, on account of their remoteness, seem to us all at the same distance; but we must not infer like the blind person above mentioned, that this is really the case; for any thing we know to the contrary, some of them may be immensely farther off than others; and analogy is rather in favour of this supposition. Experience and observation only can give us any idea of their real distances.

Accessible objects.—When the objects, whose distances we would discover, are accessible, we supply the defect of our sight by measuring from the one to the other; by finding, for example, how often a chain of 100 feet must be repeated, in order to extend from the one to the other; and in this we only perform the same process of comparison experimentally, which we had formerly carried on rudely in the mind.

Inaccessible objects.—When the objects are inaccessible, or where the route between them is any way impeded by the nature of the ground, this species of measurement is impossible; and here, therefore, our power of finding linear distance seems at first sight to terminate. But this is by no means the case; for as we have seen that angular motion is much more sensible to us than progressive motion, so our faculty of distinguishing distance is much more acute in the case of angular than of linear distance. This property of the former greatly extends our power of estimating the latter, and the distance of an inaccessible object, can always be determined within certain limits, by finding its direction from different points of view.

Every one must have observed, that, when he changes his situation upon the earth, the surrounding objects change their bearings with regard to him; they are referred to different quarters of the sky. Let a spectator at A, Fig. 6, observe the object O at the distance of a mile, bearing due west; let him now advance a mile towards the north to B, and the object will also appear to have advanced towards the south, and to have come into the direction B O C, exactly south west. It may also have been remarked, that when the object is distant, the change in its bearing corresponding to the same change in our situation is much smaller than when it is near. Suppose the object O, bearing west, is two miles off, or that the spectator is at A′, and let him here advance a mile towards the north to B′; the object will now appear in the direction B′ O C′, not nearly so much southward as at first. In the same manner, had the object been three, four, or more miles off, the spectator at *a a*′, by advancing a mile northwards, would observe a smaller and smaller change in its position. It is thus that we estimate the distance of remote objects; we change our own position, and mark the corresponding change in theirs. This principle applies with peculiar facility to the case of a number of objects like the fixed stars, situated as they probably are at different distances from the spectator.

Thus, suppose that there is a collection of objects, 1, 2, 3, 4, &c. Fig. 7. so far from the spectator at A, that their various distances from him become confounded in the common distance of a sphere C D, on whose surface he imagines them all to be placed, and of which he himself occupies the centre. Now though the objects are really disposed in a manner quite irregular, yet to the person at A they will seem to be arranged at equal distances, by threes, on the sphere C D. Let him view them from a different position, B, Fig. 8. to the right of A, and they will now seem to have arranged themselves by twos on the sphere C′ D′, of which B is the centre. Again, at the point *b*, they will appear without any order on the sphere *c d*. Let him now assume three new positions A B b, Fig. 9. much farther off, but equally distant from each other, and much less difference (hardly any indeed) will be observed in their arrangement upon the spheres C D, C′ D′, and *c d*. By observing the objects from positions still more distant, a proportionally smaller change will be remarked in the aspects which they present; and when at last the change becomes altogether insensible, we may be assured that the distance of even the nearest of the objects is out of all proportion to that of the extreme positions A B.

Distance of the stars.—But to whatever part of the earth we go, the fixed stars preserve constantly their mutual order and arrangement. We conclude, then, with certainty, from this simple observation, that their distance is out of all proportion to any that

Phenomena of the heavens, &c.

we can go upon the earth, and that in relation to it therefore the earth itself, which we at first imagined the principal part of the universe, must be considered as a mere point.

Sect. IV. *System of the World.*

From all that has been observed, it appears that Fig. 2. is a correct representation of the universe, where A B C D is the earth, and P H p the celestial sphere, with the sun, moon, and stars revolving once a-day from east to west, round the poles P p, or round the imaginary axis P p, which passes through the centre of the earth; the sphere being placed at an immensely greater distance in relation to A B C D.

In a system of bodies revolving round a centre in the same time, those that are more distant must obviously have a greater velocity than those near the centre. By the revolution of the celestial sphere, then, each star must have a velocity peculiar to itself, greater as it is more distant from the nearest pole, or from the axis of revolution, greater at *e* than at *c*, and greatest at the points E Q, intermediate between the two poles, where, as we have found the distance to be so immense, so the velocity necessary to make the stars in the circle, E Q, complete their circuit in a day, must be equally astonishing.

The stars are apparently quite unconnected with each other. If we admit their diurnal motion, therefore, it would follow as a necessary consequence, that these objects moving, some slow, some quick, and some with a rapidity beyond all conception, have at the same time their velocities so nicely adjusted, that each of them completes, with wonderful regularity, a revolution every day round the earth, which we have discovered to be a mere point in the system of nature. To obviate this difficulty, it was supposed by some astronomers, that the stars were really attached to an immense crystalline sphere, and that all their motions were to be ascribed to the daily revolution of this huge body of glass.

Motion of the earth.—Another hypothesis, however, of much greater simplicity and elegance, explains equally well the phenomena, though it is at first strongly opposed by the prejudices of our senses. This hypothesis converts the apparent motion of the stars, into a real motion of the earth round itself, in a contrary direction, in such a manner that its axis of rotation, P′p′, Fig. 2. points to the celestial poles, or coincides with the celestial axis. The appearances will evidently be the same whether we attribute the motion to the one or the other, whether we suppose the portions of the celestial sphere to be brought successively over our heads, or ourselves to be carried successively under them, by the effect of the earth's rotation, in a contrary direction. Let a spectator at A, Fig. 10. view the stars *a b c d*, and the moon M; *a* just rising above the horison H A O; *b* towards the east, and considerably elevated; *c* directly over his head, and *d* towards the west; let him view them again in a short time, and he will observe that they have all made an advance towards the west, as in Fig. 11. Now, it is obviously the same to the spectator whether these bodies have been actually carried into their new position, along with the sphere *a b c d*, as in Fig. 11. or he himself has been carried, by the earth's rotation, from west to east to the point A′, Fig. 12. and his horizon with the point directly over his head to the position H′A′O′ and *c*; whether the one or the other of these events has happened, he will still see, at the second observation, the star *a* and the moon at the same elevation, *b* directly over his head, and *d* in the horizon. Since the appearances are absolutely the same then in either case, let us see to what objections the latter is liable from other quarters.

We have frequent examples of such a motion. A ball tossed from the hand, while it rises into the air, turns at the same time round itself—or round an imaginary line passing through its centre, and termed *its axis*. Observe also the tops with which boys amuse themselves; while they advance by continued impulsions, they have at the same time a rapid rotation round their points.

But however agreeable to nature, it still requires no little effort to credit the existence of a motion to which we ourselves are subject, which remained unknown for ages, and of which we are even now altogether insensible. Observe, then, what happens to every one who is thus carried along by some external impulse. In sailing close along the coast, and in smooth water, while we remain in the cabin, and see no external object, we are utterly ignorant whether the vessel is going quickly or slowly, or whether indeed it has any motion at all. But, when we come upon deck, we instantly perceive an apparent motion in all the external objects, which experience and habit have taught us belong to the vessel, but which, on our first viewing the phenomenon, we would infallibly have ascribed to the objects, as it is even yet often difficult to resist the illusion. Without experience, indeed, we could have no reason whatever to refer the motion to the one more than to the other, except perhaps its being simpler in one than in a variety of objects no way connected together. So it must happen to us on the earth; whatever motion it may have, provided all the objects around us participate in it, and we ourselves participate in it, we are no more sensible of it than if it had no existence. But when we look beyond the earth, and observe a motion common to all the external objects, the sun, the moon, and the stars, we can have no reason whatever for ascribing it to the objects rather than to the earth, while analogy and a regard for simplicity are in favour of the latter hypothesis. The question, however, can only be decided by more continued observation and reflection. In the mean time, we shall continue to speak of this motion as belonging to the stars.

Chap. II. Phenomena of the Sun and Moon.

Let us now consider more particularly the Sun and Moon. These bodies seem far to surpass the stars in magnitude and brightness, and it is easy to observe, that they are equally distinguished by motions peculiar to themselves.

Sect. I. *Of their Distance, Figure, and Magnitude.*

We cannot, by merely viewing these objects, form

Phenomena of the sun and moon.

any idea of their distance, and, therefore, the one may be much farther off than the other; but their superior magnitude and brightness,—the striking effects which they produce upon the earth,—and their peculiar, or *proper* motions, as they are termed, might all incline us to place them both nearer to us than the stars. What are we to think of their figure and magnitude? Like our earth, they are insulated in space; and though they appear like thin plates, the one of fire, the other of pale light, we must not infer from this that they have really no thickness. There is hardly such a thing on earth, if it be not the productions of art, as an object without a thickness in some degree proportioned to its length and breadth. All spherical bodies, besides, present the same appearance when sufficiently remote. As the sun and moon, therefore, would have exactly the same appearance though we should ascribe to them, like our own globe, a roundness in every direction, it is natural to adopt this supposition, which analogy points out, and to try it by future observations.

Though the sun and moon seem so small in respect to the objects around us, their real magnitudes may be very great; as the hugest man of war, on the distant horizon, appears no bigger than a boat, or as a person at a great elevation observes all the inferior objects on a reduced scale. Thus, to a spectator at A, Fig. 13. the object C D seems smaller and smaller as its distance increases; so that we have no idea, at sight, of the real magnitudes of distant objects.

Of near objects we can no doubt form at once a pretty correct estimate of the real size; and we would think it strange in a person to suppose an object any larger, because, on being brought closer to his eye, it occupies nearly the whole field of his view. This, however, arises entirely from our habit of distinguishing distance at sight. The blind person couched by Cheselden, when a small object, perhaps only an inch square, was placed before his eyes, so as to conceal from him a large house, found it impossible to conceive at first how the house could be any larger than the object, or the object any smaller than the house. It is the same with us when we look at the sun and moon. We are entirely ignorant of their distances; and the deception as to their real magnitudes is equally complete. For aught we know to the contrary, therefore, they may equal, or even surpass in bulk our own globe itself.

The sun and moon appear much fainter and larger in the horizon than when a little elevated. The faintness is principally owing to the fogs and vapours that are generally spread through the air in the horizon, and in passing through which the light of those bodies is considerably interrupted. Their greater apparent magnitude in the one case than in the other is generally ascribed to our imagining them at a greater distance in the horizon, where houses, trees, mountains, and other objects intervene, all whose distances we know and can compare with that of the sun or moon, than in the sky, where no objects intervene, and where we, therefore, imagine them much nearer us than before. To be convinced that it is an illusion, it is only necessary to observe the sun or moon through a tube small enough to admit in its field of view only the moon itself, or through a small hole in a piece of paper, or through a glass so smoked, that, by placing the eye close to the glass the moon only can be seen; it then appears of the same magnitude in both cases.

Sect. II. *Of the Moon.*

The motions of the moon are the most remarkable, both for their rapidity, and for the singular changes of her shape with which they are accompanied. She is sometimes observed towards the east of the sun, sometimes towards the west, and sometimes directly opposite to the sun. Sometimes, again, she assumes the form of a whole circle of light, sometimes a half circle, sometimes a slender crescent, and sometimes disappears entirely from the heavens. But as we are continually losing sight of terrestrial objects when other objects intervene, or when the light that is necessary to perceive them is withdrawn, as when a vessel at sea disappears behind some island, and reappears in a short time on the opposite side, or when the whole sky is obscured by clouds, or when all the objects in a room disappear upon extinguishing the candle; it is natural, therefore, to ascribe the moon's disappearance to the effect of some such circumstance. A close attention to her motions may unfold the true cause.

Her proper motion.—If the moon be observed attentively when a little westward of some brilliant star, it will be perceived, in the course of the night, that though they are both making advances towards the west, the moon is at the same time gradually approaching the star, to which at last she arrives; the star disappears behind her, and in a little time emerges on the opposite side, exactly as happens when an opaque or untransparent body coming between us hides the distant objects. Next evening the star will be observed considerably westward of the moon.

Either, then, the moon has in reality a slower motion from east to west than the stars, or she participates equally with them in the diurnal motion, while she has, at the same time, a contrary and a slower motion from west to east peculiar to herself, by virtue of which she falls behind in the general motion. The appearances are the same in either case; for when we observe the moon to-night at M, Fig. 14. west of the star S, and to-morrow night at the same hour at m, east of the star S, the effect is evidently the same, whether we ascribe to M a single motion from west to east, which in the course of 24 hours would carry her over the arc M O C H m, while the star is carried, by the diurnal motion, all the way round from S to S again, or that we suppose m actuated in common with the star by the diurnal motion, which would carry her in 24 hours all the way round from m to m again; but that she has, at the same time, a contrary motion of her own, which in 24 hours carries her over the arc M m from west to east. As this last is what would certainly happen by ascribing the diurnal motion to the earth, and not to the stars, therefore, till further experience decide the question, we shall speak of it in this way, and suppose the moon to partake of the general motion of all the stars from east to west, (from the left to the right, when one looks to the south,) while she

Phenomena of the sun and moon.

has a motion of her own in a contrary direction from west to east, called her *proper* motion.

Sometimes the moon rises nearly at the same point of the horizon where the sun had risen in the morning, and follows him nearly through the same arc of the heavens to the horizon again; sometimes she rises much farther to the south, and sometimes much farther to the north of this point, mounting respectively to a less or more considerable elevation, and setting also farther to the south or north. In following the series of her *phases*, we shall, for the sake of simplicity, suppose her to remain in the same circle of the sphere *a b c d*, Pl. 24. Fig. 1. with the sun.

Phases.—The moon's changes of figure and situation are soon discovered to be successive, and closely connected together. At the time of *new moon*, when she first reappears in the sky, under the form of a slender crescent, after having been invisible for a few days, it is always in the evening towards the west, but eastward of the sun, the horns of the crescent also pointing to the east nearly as at *a*, the sun, S, being in the horizon H O.

Each succeeding evening, when the diurnal motion has brought the sun to the horizon, the moon appears to be farther and farther (we mean here obviously her angular distance) from the horizon, and from the sun; to set later and later after the sun; and to be thus making continual advances towards the east. Her size also is at the same time observed to increase, the concavity of the crescent gradually filling up, the horns becoming less and less pointed, and the whole figure merging into a semicircle as she approaches the position *b*, which she attains in a few days, having overtaken and eclipsed in her passage the bright star S.

It is then *half moon*, or she is said to be in her *first quarter*. But the same appearances continue for another week, till she arrives at a point *d* opposite to the sun, having successively assumed all the intermediate angular positions from *b* to *d*, and all the intermediate figures from the half to the whole circle.

It is now *full moon*, or she is now said to be *in opposition*. She now rises at sun-set, and sets at sun-rise, and shines through the whole of the night. But as she is now at her greatest distance from the sun, for she evidently cannot advance farther in her circle of revolution, *a b c d*, without approaching the sun; and as her shape is now also complete; as these changes of situation and figure have both attained their *maximum*,—they now begin to run in a contrary direction, and all the preceding phenomena to occur in a reverse order.

Each succeeding evening the moon rises later and later after the sun; or, if the observation be made in the morning, she appears in the west at sun-rise, and farther above the horizon every day, and still, therefore, advancing towards the east, but now approaching the sun, as in Pl. 24. Fig. 2. When, in the course of another week, she comes to the position *f*, Fig. 1. or Fig. 2. her figure being now reduced to a semicircle, it is again *half-moon*, or she is said to enter her last quarter. Her figure now decreases in approaching, as it had formerly increased in receding from the sun; her horns, at the same time, pointing towards the west, as they had formerly done towards the east, in both cases *from* the sun. In the course of a few days we cease to perceive her at all; and it can hardly be doubted that it is the same identical object which in a few days more makes its appearance in the evening to the east of the sun; having, in the mean time, just performed, though invisible to us, the remaining and intermediate series of her changes of position from *g* to *a*, and of figure from the crescent to the crescent again, after a period of complete evanescence at the position *h*, being then, at the same time, neither east nor west of the sun, her angular distance, therefore, having also become nothing. This is the *change* of the moon; and having now attained the *minimum* of her changes, she just recommences the same series.

The period of all these phases is about 29 days and a half, and is called *a lunar or synodical month*, or simply a month. It is the interval that elapses between two successive new moons, or two successive changes, or between two successive arrivals of the moon, at her first or last quarters.

Whatever, then, be the nature of her changes of figure, the moon seems evidently to describe a circle in the heavens, in going from west to east, from the sun to the sun again, once in a month, rising all the time in the east, and setting in the west, every day.

It very rarely happens that the moon, when she comes into the position *h*, being then neither east nor west of the sun, is at the same time (as we have supposed in the figure) neither north nor south. By observing the points of her rising and setting before and after her entire disappearance, we find that, at the change, she is most frequently more or less either to the north or south of the sun, (either a little above or below the paper in the figure.)

But though it is very seldom that these bodies are exactly in the same direction, yet as we have found them to be in a position, at *h*, neither east nor west of each other, once every month, the one being at that time more or less north or south of the other, (above or below the paper;) and as it is observed that they are also, once every month, neither north nor south of each other, being at that time the one more or less east or west of the other; as these two conditions thus occur separately once every month, it is certain that, in the course of ages, they will be united at one time, and the sun and moon will occupy the same angular position.

In that case it is plain, that were the sun and moon at the same time equally distant from the earth, they would both occupy the same identical portion of space; this is impossible, if, as is probably the case, they are composed of solid matter, like our earth; there would then infallibly arise a collision between them, and a consequent derangement of the moon's motions. But as this never happens, it is more natural to conclude, that the moon passes either beyond or between us and the sun. In the latter case, were the moon composed of opaque or untransparent matter, like our earth, it is certain, that, coming so directly between us, she would hide the sun from our view, as when we pass an object between us and the candle; she might then spread total darkness over the earth, and so remarkable a phenomenon

Phenomena the sun and moon.

would undoubtedly be recorded either in history or tradition.

Eclipses of the sun.—But it is well known that we have the most authentic accounts of *total eclipses of the sun*, which, in ignorant ages, were regarded with terror. In these phenomena, the western border of the sun, which first disappears, is also the first to re-appear, as he successively assumes the figures 1, 2, 3, &c. Pl. 21. Fig. 3. exactly as would happen by a round opaque body passing between from west to east.

Partial eclipses of the sun, of various extent, are also observed, on some part of the earth, every year, in the middle of which the sun assumes all the forms, 1, 2, 3, &c. Fig. 3. Sometimes, too, at the middle of the eclipse, the whole opaque body is observed like a large spot in the sun, whose exterior border projects all round like a ring, Fig. 4. This is called an *annular* eclipse.

Now, it is certainly much less agreeable to any thing hitherto observed, to suppose that the sun really loses and recovers his light by some internal arrangement, of which we can give no sort of account, than to admit the most common fact of an opaque body shading an enlightened one. And as we can discover no body in the system, except the moon, of sufficient magnitude to obscure so completely the whole, or even so great a portion of the sun's disk as we often observe in a common eclipse; as the eclipse also invariably happens about the middle of that interval that elapses between the moon's disappearance in the morning, to the west of the sun, and her re-appearance a few days after in the evening to the east of the sun, and as the opaque body seemed to move over the sun from west to east, the direction of the moon's proper motion, it can hardly be doubted, from all these circumstances, that the opaque body which thus darkens the sun is the moon.

Eclipses of the moon.—But the moon is herself subject to eclipses, both total and partial, in which her darkened portion sometimes disappears entirely, and sometimes is still faintly visible, though very much obscured. But here it is the eastern portion of her disk which first disappears, and is the first to re-appear, just as if, in her course from west to east, and deriving nearly the whole of her light from the sun, she had entered and passed through the shadow of a round opaque body. Now we are quite certain that the earth is opaque, and almost equally so that it is round; at the time of an eclipse, also, the moon is always at the full, and directly opposite to the sun, the earth being so exactly situated between them as to cast a shadow behind itself, which might fall upon the moon. As we can disoover no other body in the heavens, uniting so many requisites for producing an eclipse, it amounts almost to certainty, that this is the true cause of the appearance, and it confirms the above explanation of the solar eclipses.

As the moon disappears when the light of the sun is withdrawn by the earth's interposition, and gradually re-appears as she emerges from the earth's shadow, exactly as it happens to all dark objects when deprived of the light necessary to perceive them, as the objects in a room disappear upon withdrawing the candle, and re-appear when we re-admit it, we conclude that the moon derives her light from the sun, and that it is only by his shining upon her that we ever see her in the sky, in the same manner as we often observe distant spots of ground and the objects within them become brighter and more visible than the surrounding ones, as the sun shines upon them through openings in the clouds.

Phenomena of the sun and moon.

Explanation of her phases.—The moon then seems to resemble the earth in the properties of opaqueness and want of internal light. If we extend the analogy to the property of roundness in every direction, which is certainly probable, we shall have a very elegant explanation of the monthly variations in the extent of her light.

For as it is clear that no more than the half of a globe can be enlightened by a candle at a time, and also that no more than its half can be seen by us at a time, so it will happen with the globe of the moon: no more than one-half of her surface, or a hemisphere, can be enlightened by the sun at a time, while no more than that half of her which is next us can be seen by us at a time. The moon, then, will always have one hemisphere wholly dark, and the other wholly enlightened. Now, if it should happen, that the hemisphere which is next to us should be at the same time the one which is wholly darkened, it is plain that we could no more perceive the moon than if she had no existence; and, on the other hand, if that side of the moon which is turned towards the sun should be, at the same time, wholly enlightened, it is equally clear that we should see her under the form of a complete circle. But the one of these cases would obviously happen at the change of the moon, when she is between us and the sun, as at *h*, Pl. 21. Fig. 15. (being then most commonly either north or south of the sun, above or below the paper in the figure,) for then her enlightened half, A B C, would be turned from us, and the dark half towards us; the other case would happen at full moon, at *d*, (she being then, as before, a little north or south of the sun,) when the enlightened half, A B C, is towards us, and the dark half from us; the line A C, which separates the light from the dark hemisphere, coinciding in both cases with the line which separates the half that is next us from the half that is opposite us.

Now, these appearances which we have thus anticipated from theory, are exactly what we observe in following her phases. At the change of the moon she is always invisible, and at the full moon she seems a whole circle of light, except in the case of eclipses, when she is seen, on the one hand, like a dark spot upon the sun, and, on the other, is concealed by the shadow of the earth. It is, therefore, more and more probable that the moon is a spherical body, and that she appears and disappears successively, in consequence of being brought, by her monthly revolution round the earth, successively between and opposite to the sun, the source of her light.

Moon much nearer us than the sun.—This conclusion would be farther verified, could we compare her observed semicircular appearances in her quarters with the theoretical deductions. But her appearances at her quarters must depend upon the linear distance of the sun. Let S, Fig. 15. be the sun, and A a B C c D, the moon in her first quarter; then A a B C will be the enlightened half, and D A a B

Phenomena of the sun and moon.

the half next the earth; in this case more than the half of the moon will evidently be visible, nearly in proportion as the enlightened portion, A a B, of the half next the earth exceeds the dark portion, AD. If our theory be correct, then the sun cannot be in the position S, for we should then see more than the half-moon at quarters, which we do not. Neither can he be at s, or *s*, for though we should then see less extent of light than formerly, we should still see more than the half-moon, in proportion as a B exceeds a D. It is evident, therefore, that the figure which our theory would ascribe to the moon at the quarters, approaches to a half circle, as the sun is supposed to be farther and farther from the earth,—as his distance is supposed to bear a less and less proportion to that of the moon. Now, as the moon's figure at her quarters is actually observed so near as not to be distinguished from a half circle, we may conclude from this simple observation that the sun's distance from the earth is so great as to bear a very small proportion, indeed, to that of the moon.

It is to the sun's immense distance, then, which is no way inconsistent with any of our observations, rather than to any error in a hypothesis which explains all the phenomena by a law of so much simplicity and elegance, that we are to ascribe the moon's semicircular appearance at her quarters. And since she thus disappears entirely at the change, and gradually increases till she arrives at the full, by her enlightened hemisphere coming more and more into our view, it is easy to conceive that she must go through all the intermediate gradations, from the fine thread of light to the crescent, from the crescent to the half moon, and from the half to the whole circle.

And much smaller.—The moon being so much nearer us than the sun, and still only appearing of the same magnitude, must necessarily be smaller in the same proportion, as the object C D, Fig. 13. in order to have the same apparent magnitude when transported to E, must be really enlarged to the magnitude *c d.*

We may conclude, then, upon the whole, that the moon, like the earth, is a round opaque mass of matter, without internal light, insulated in space, much less distant, and therefore much smaller than the sun, and revolving round the earth from west to east, from the sun to the sun again, in $29\frac{1}{2}$ days, while she, at the same time, participates in the general motion of all the stars from east to west, rising and setting every day.

Sect. III. *Motions of the Sun.*

Annual motion.—To follow the proper motions of the sun, let a spectator, at any time of the year, remark a brilliant star, or group of stars, setting a little after the sun. In a few nights after, if he look again to the same quarter of the sky, he will no more perceive the same stars, but a quite different group, setting after the sun. On looking, however, in a few days more towards the east, the stars which he had missed in the west will now be observed near the horizon a little before sun-rise, and therefore eastward of the sun. Since the sun, then, is observed first on the west and then on the east of the same stars, he seems evidently, like the moon, to be making a progress among the stars towards the east, which, being more gradual, it only requires a little longer observation to perceive.

Phenomena of the sun and moon.

Each succeeding week the sun will be observed to rise later and later after the group of stars; new stars will successively disappear in the splendour of his rays, and re-appear when it is withdrawn by his eastward advance, and in the period of about $365\frac{1}{4}$ days, which forms *the year*, the same star as before will be observed to set a little after him in the evening; he is then in the same position as before relatively to the stars, after having made the complete circuit of the heavens. The sun, then, like the moon, seems also to revolve round the earth, though in a much longer period, and this is called his *annual* motion.

Equator.—But there is one circumstance regarding this motion, that must be particularly remarked, on account of the important consequences that arise from it. The proper, or annual motion of the sun, is not directly contrary to the diurnal motion; it is not due east, and would not be accurately represented by supposing the sun attached to a sphere which should revolve upon the same axis with the celestial sphere, but in a contrary direction, and only once in a year. For example, let P Q p E, Fig. 1. be the celestial sphere, revolving round the earth A, a mere point in relation to the sphere, on the axis P p, and in the direction E A Q, each star, a, 1, E, t, describing the circles a b c, 1 b 2, &c. which must be conceived to rise in relief above the paper towards the centres, b b, &c.; that circle, E A Q, which is equally distant from both the poles, (E P being equal to E p, and Q P to Q p,) is called the *equator*. Suppose, now, the sun to be at E, describing the equator, E A Q, by the effect of the diurnal motion, it is evident that, were his annual motion directly contrary to this, he would be always in the equator, moving in the direction Q A E, from Q all round to Q again, in a year; he would always therefore rise at the same point of the horizon, and ascend to the same height, H Q, in the sky, making the days always of the same length; nor would he ever advance any nearer to the north, or any farther from the south pole, at one season than at another, but would always remain equally distant from either.

The slightest observation, however, is sufficient to shew how far he really deviates from this imaginary course. For if, in the heat of summer, a spectator stand with his face to the south, he will then observe the sun rise behind him, ascend to a great elevation, and set behind him; while in the middle of winter he can observe, without turning himself, both his rising and setting, the height to which he ascends being also much less than formerly. From this period the sun is observed to rise and set farther and farther towards the north, and to mount higher and higher into the sky every day, until the middle of summer, when he returns in the same manner towards the south.

Tropics—Ecliptic.—That point of his course where the sun arrives in the middle of summer, when he is nearest the north pole, and just beginning to return to the south is called the *tropic of Cancer*, and that point where he arrives in the middle of winter, when he is nearest the south pole, is called the *tropic of Capricorn*. The one is at the same angular distance from the north that the other is from the south pole; so that the orbit of the sun—the annual circle of

Phenomena of the sun, moon, &c.

the heavens which he describes—and which is called the *Ecliptic*, crosses the equator, lying the one half towards the north, and the other towards the south pole, and the two circles have thus the appearance of two hoops, Fig. 17. crossing each other at a small obliquity. Thus, in Fig. 1. if E A Q be the equator, R A t will be the ecliptic, the one being inclined to the other by the angle Q A R, which is nearly one-fourth of a right angle. When the sun is in the tropic of Cancer at the point R, he then describes, by the effect of the diurnal motion, the circle R T, rises at the point d, ascends to the elevation H R, and makes the days longer than the nights, in proportion as the arc $d\,b$ R above the horizon exceeds the arc d T below it—while his arrival at the tropic of Capricorn, in the middle of winter, exactly reverses the situation of day and night—the arc $f\,r$ being now equal to d T, and $f\,t$ to d R, so that the day is now shorter than the night in the same proportion as in summer it was longer. The sun now rises at f, much farther towards the south H, and ascends only to H r; in returning towards the north, the day is continually lengthening, and the night shortening, till it again reach its maximum at R, while, at the intermediate point Q, when the sun describes the equator by the diurnal motion, the day is equal to the night, Q A being equal to E A. It is from this circumstance, therefore, of the sun taking a direction oblique to the equator, that arises all the variety of the seasons.

In every season the sun is in a different part of the ecliptic; and, to express these various positions, this circle is conceived to be divided into 12 equal parts, called *Signs*, of which the following are the names, the characters, and the months, about the 22d day of which the sun enters them:

Aries ♈	*Taurus* ♉	*Gemini* ♊	*Cancer* ♋
March	April	May	June
Leo ♌	*Virgo* ♍	*Libra* ♎	*Scorpio* ♏
July	August	October	September
Sagittarius ♐	*Capricornus* ♑	*Aquarius* ♒	*Pisces* ♓
November	December	January	February.

These names are taken from certain groups of stars lying on each side of the ecliptic, whose figures were thought to resemble those of the above animals. The space in which these figures are included, forms a zone or belt all round the sphere, and the ecliptic is in the middle of it. This zone is termed the *Zodiac*, and the signs *Signs of the zodiac*.

The proper motion of the moon is not directly contrary to the diurnal motion any more than that of the sun, though we supposed this to be the case in considering her phases, in order to simplify the appearances. In the middle of winter, when both the rising and setting of the sun can be seen without turning from the south, the moon, in disengaging herself from the sun, is observed to rise and set nearly at the same points, and ascend nearly to the same elevation in the sky. But being observed at the full, she is seen to rise and set behind the spectator, looking to the south, and to mount to a great elevation in the sky.

The planets.

The reverse of this happens in the middle of summer. The moon then rises with the sun, at the change, to a great elevation, and at the full seems to be in the opposite part of the ecliptic, rising and setting nearly as much towards the south as the sun rises and sets towards the north, and not ascending nearly to so great an elevation.

The moon then describes, in a month, nearly the same circle of the heavens which the sun describes in a year. That she does not, however, describe exactly the ecliptic is evident; for, let S, Pl. 22. Fig. 1. be the sun in the ecliptic S C A, M the moon, in her orbit M B, if we now suppose M B to be in the same direction with A S, that is, if M B neither rises above nor fall below the paper at any point, but is wholly coincident with it,—then M will come directly between the sun and earth E, and we should thus have a solar eclipse once every month, which does not happen. The moon's orbit then is a little inclined to the ecliptic.

Sun's motion only apparent.—The motion of the sun round the earth may be only apparent, and owing to a real motion of the latter round the former; for the appearances relatively to each other would be the same in either case. If we suppose, however, the earth to move round the sun, it must carry the moon along with it; for, let the earth E, Pl. 22. Fig. 2. in moving round the sun S, come into the position e,—if the moon M, in revolving round the earth, were not also carried with the earth round the sun, she would be occasionally observed beyond the sun, which never happens. Either, then, the sun and moon move round the earth, in concentric circles, as at Fig. 1.; or, the earth, E, Fig. 2. moves round the sun S, and carries along with it the moon M, which at the same time revolves round the earth once every month. The latter supposition seems certainly the least simple of the two; but it is only by comparing it with the rest of the system that we can decide which to adopt.

Chap. III. Of the Planets.

Five bodies, besides the sun and moon, are observed to have motions peculiar to themselves, while they all participate in the diurnal motion, rising and setting every day. They are called *Planets*, or wandering stars, those only in which we observe no proper motions being called *fixed* stars, from which also the planets are distinguished by having less (hardly any indeed) of what is called the *twinkling* of the stars. They have been known from the remotest ages; and the following are their names and the characters by which they are distinguished:

Mercury,	Venus,	Mars,	Jupiter,	Saturn.
☿	♀	♂	♃	♄

Distances.—As these bodies, like the sun and moon, seem to move among the stars without ever being hid from us by them, or impeded in their progress, they are also probably nearer us than the stars.

Venus.—Every one must have observed a beautiful star in the west, which sometimes shines with uncommon lustre in the evening, a little after sunset, and is called the *evening star*. This is Venus. By observing her for successive nights, we find that her distance from the sun remains not always the same. After her first appearance, she is observed on the succeeding evenings to set later and later after the sun, and thus seems gradually receding from him towards the east, till she arrives at an angular distance, equal to about a quarter of the hemisphere. This happens about two months from her first appearance. She then begins to return towards the sun, to set each night sooner and sooner after him, and at last disappears in the splendour of his light.

But, in a few days, a brilliant star makes its appearance in the east, a little before sun-rise, called the *morning star*. It is observed the succeeding mornings sooner and sooner before sun-rise, and seems therefore to be receding from the sun towards the west. This digression continues for a period of about two months, when the star has attained an angular distance from the sun equal to about one-fourth of the hemisphere; it then seems to return towards the sun, rises later and later every day, at last overtakes the sun, rises along with him, and we no more perceive it. It is a few days after that we discover again in the west, the evening star disengaging itself from the sun's rays, and again gradually advancing towards the east; and the striking resemblance between the two objects which thus succeed each other in the sky, their never having been observed together, their proceeding in the same periods to the same angular distances from the sun, and the observation of all these phenomena for ages together, leaves no room to doubt that it is the planet Venus which thus becomes alternately the morning and evening star, as she seems to oscillate on each side of the sun.

Mercury.—Mercury exhibits the very same appearance as Venus, on a smaller scale. Its oscillations on each side of the sun are confined within less than one-sixth of the hemisphere; and it is on this account less disengaged from the sun's rays and seldomer observed. It seems also smaller, but sometimes very brilliant.

Real motions.—These oscillations, however, may be only apparent. For as it is certain, that whatever progressive motion, relatively to the earth, these bodies may have, we can no more perceive it, on account of their distance, than if it had no existence. So if we ascribe to them a motion of revolution round the sun, the same oscillatory appearances would still be observed. Suppose, for example, Mercury M, Pl. 22. Fig. 3. and Venus V, to move in the circles M m, V v, round the sun S, and to be viewed by a spectator on the earth at so great a distance that they may successively assume the positions 1, 2, 3, 4, without appearing in the least degree to have receded or approached him, it is evident that they would seem to him to move in the lines M m, V v, from V to v, and from v back again to V; sometimes from west to east, or *direct;* sometimes from east to west, or *retrograde;* and sometimes, near the points V, v, to remain quite *stationary*; while, to a person at the sun, they would seem, like our moon, to move always in the same direction; just as a horseman, running in a circle, when viewed from a great distance, seems to move first in one direction and then in the opposite; while, to a person within the circle, he moves always one way.

Inferior and superior planets.—Mercury and Venus are called *inferior planets*, because they keep within a certain distance from the sun; the others recede to every possible angular distance, and are called *superior*. They are sometimes observed, like the moon, in opposition to the sun, beyond the earth, and sometimes at every intermediate angular distance, till they disappear in his rays. They keep, however, always within certain limits of the north and south, and never advance much farther than the sun towards the north or south pole, so that their paths, like the moon's, are slightly inclined to the ecliptic. They seem also to move with great irregularity, but they resume the same series of changes after certain periods. Sometimes their motion seems direct, sometimes retrograde, and sometimes they appear to remain for considerable periods in the very same position among the stars. As it is certain, however, that these bodies, though thus apparently stationary, may in reality be moving with the same velocity as before, while the mere circumstance of their motions being now progressive relatively to the earth, might conceal it entirely from our view; so all their irregularities, like those of Mercury and Venus, might vanish to a spectator on the sun.

Chap. IV. Solar System.

There is, accordingly, a hypothesis, which confers the greatest simplicity on these complicated appearances. It supposes the superior, like the inferior planets, to circulate round the sun at greater distances, as they are longer of completing their revolutions, according to the order above enumerated. It supposes also the sun and planets to form a distinct group in the system of the world, separated all round from the fixed stars by a distance almost inconceivable. And by converting the apparent motion of the sun round the earth into a real motion of the latter, along with the moon, round the former, it adds the earth itself to the list of the planets, while, by ascribing to it at the same time a daily rotation on its axis, it renders illusory the diurnal motion of the stars.

We have here a system, at all events, of order and consistency; a set of bodies of various magnitudes moving at various distances, and in various periods, round a great centre of heat and light; a system, also, according to which the apparent confusion of the planetary motions arises entirely from our viewing them from a disadvantageous position.

Our position upon the earth would have this effect in two ways; first, being out of the centre round which the planets revolve, they would be nearer us in one part of their course than in another; and would, on this account, appear to move quicker at one time than at another, though their motions round the sun were perfectly uniform. Thus, let E, Fig. 4. be the earth, which we shall suppose at rest, and P one of the superior planets moving round the sun S, in the orbit P A B C. Advancing from P, in the direction P A B C, the planet will evidently recede

Solar system.

from the earth till it arrives at B, and will then approach till it returns to its first position. Suppose it now to move *uniformly* round the sun, that is to say, to describe equal portions of its orbit P 1, 1 2, 2 A, A 3, &c. in equal times in each month for example, it is clear, that p a b c, representing the celestial sphere, p, 1, 2, a, &c. will be its positions among the stars, as seen from the earth,—the points of the celestial sphere in which it is observed at the end of each month. Though the planet then really describes equal portions of its orbit every month, yet to a spectator on the earth, out of the centre of the planetary motions, it will seem to describe among the stars smaller and smaller spaces, P 1, 1 2, 2 A, A 3, &c. as it approaches B; to him, therefore, it will seem to move slower and slower as it advances to B, and quicker and quicker as it advances from B to P.

Secondly, The *motion* of the earth would have a sensible effect upon that of the planets. Every one must have remarked how much his own motion affects the apparent motion of the surrounding objects. A traveller in a coach observes the trees and houses that border the road pass by him with great rapidity, while the more distant objects remain longer in view, and seem nearly at rest. In this case, our own motion makes us ascribe motion to bodies at rest. It has often, however, the contrary effect. A spectator on shore remarks a rapid motion in a vessel at sea, while the passengers in the cabin, if they are sailing in smooth water, imagine themselves, as well as the objects around them, in complete repose.

The motion of an object, indeed, is nothing else than the continued change of its position, that is, of its linear or angular distance—its remoteness or its direction relatively to the observer; its direction being estimated from that of one or more known objects which we suppose at rest, as that of a spire, a signal post, or the north or south. Now, we always remark a change in the position of the surrounding objects, as well when we change our own position as when they change theirs. Our distance from a vessel at sea is continually diminishing, whether we approach it or it approaches us. The vessel seems also to advance towards the north or south, either when we stand upon the shore and observe it actually sailing in these directions, or when the vessel is at anchor, and we ourselves are travelling towards the south or north. The apparent motion of an object, therefore, necessarily varies with the motion of the observer. So it will happen, according to the above theory, with the motions of the planets. Their real motions, relatively to the fixed stars, which an observer at the sun would only remark, will, to a spectator on the earth, be combined with his own motion round the sun; and these two being sometimes in one, and sometimes in opposite directions, their joint effect will be extremely irregular. Thus, let E, Fig. 5. be the earth, and P one of the superior planets, setting out together from the points E and P, and moving uniformly round the sun, the earth in one, and the planet, suppose, in eight years; then will P, 1, 2, 3, &c. and E, 1, 2, 3, &c. be a series of their corresponding positions, the planet having only advanced to 1, when the earth has gone over one-fourth of its orbit; the former also being only at 4, when the latter has completed its circuit, and so on.

2

Fixed stars.

Let A B C D represent the sphere of the fixed stars, to which we refer the position of the planets, and let A B C D be the direction from west to east in which they move when their motion is said to be direct; then will p, 1, 2, 3, 4, &c. be the series of the planet's position among the stars, as seen from the earth, corresponding to its actual positions, P 1, 2, 3, &c. in its orbit, as seen from the sun. When the earth is moving from E to 1, the planet will seem to be moving from p to 1, contrary to the direction A B C D. Though both the earth and planet, therefore, are really moving direct, the latter, to an observer on the former, will seem to be retrograding. While the earth moves over the next quarter revolution, from 1 to 2, the planet will seem to move from 1 to 2; its motion, therefore, will now be direct; while the earth advances to 3, E, the planet will seem to advance to 3, 4; but when the former comes again to 1, the latter will seem to have returned to 5. In the next revolution of the earth, the planet will seem to advance successively to 6, 7, 8, 9; but when the former arrives at 1, the latter will seem to have returned to 10. The same irregularities continue through the whole of the planet's course; and it is easy to conceive, that, during each transition of its motion from direct to retrograde, and from retrograde to direct, there must necessarily be an interval of apparent repose. These effects are considerably modified by the amazing distance which the theory ascribes to fixed stars; but it will easily be perceived, in general, from what has been said, how the planetary irregularities might be accounted for in this way.

The above system has been called the *Solar* or *Planetary*, and sometimes the *Copernican* system, from Copernicus, a Prussian, by whom it was revived and illustrated, after having been neglected from the age of Pythagoras, who is said to have first proposed it. It could hardly have been suggested by any observations that could be made without the aid of instruments; but we have given the above outline of it, that, in treating of the discoveries of more precise observations, the reader may be the better enabled to discern how admirably they all bear upon this grand point.

Chap. I. Of the Fixed Stars.

Number of the stars.—Viewed in a clear winter night, when there is no moon-light, the stars appear quite innumerable; but, upon a closer inspection, and by only examining one group at a time, a spectator will be surprised how few are visible in the whole hemisphere. In this manner, it is found, that a good eye can scarcely ever distinguish more than a thousand.

Constellations.—To distinguish the individuals of such a number of objects, the usual mode has been adopted of dividing them into classes, which were termed by the ancients *Constellations*, and each of which they designated by the name of some animal which the figure of the group was thought to resemble. The stars of each constellation are then distinguished by the letters of the Greek alphabet, according to their magnitudes, the largest being term-

Fixed stars.

ed α, the next β, and so on. In this manner, every star in the heavens has a particular name; and thus the astronomer, to whom they serve as so many fixed points, with whose positions he compares that of the planets, is at no loss to describe the particular star he may have in his eye.

Magnitudes.—The stars of each constellation, however, have in many cases particular names, besides that which they receive from the Greek alphabet. Thus, the largest in the constellation of the Lion is called *Regulus*, as well as α of the Lion; and the whole stars have also another arrangement, according to their *magnitudes*.

Those which seem the largest and brightest are called *stars of the first magnitude*. The smallest that can be seen with the naked eye are of the *sixth magnitude;* and the intermediate ones, according to their sizes, are of the *second*, *third*, &c. magnitudes.

Principal stars.—Let a spectator observe the heavens in a clear winter night of the month of December or January, and about ten o'clock he will observe a very remarkable group of brilliant stars towards the south, and considerably elevated above the horizon. This is, the constellation *Orion*. Of four bright stars, arranged in an irregular square, the two highest form his *arms*, and the two lowest his *legs*. In the centre of this quadrilateral are placed in an oblique line, and quite near each other, three other bright stars forming the *belt* of Orion, and beneath these are three others of inferior lustre, which are thought to design his faulchion. The three stars of the belt, which are sometimes also termed the *three kings*, point on one side to *Sirius*, or the *Dog-star*, and on the other to the *Pleiades*. Sirius is that remarkable star distinguishable from any other by its scintillation and lustre; it is to be seen on the south-east side of Orion.

The Pleiades, or the Seven Stars, lie on the north-west of Orion; they are very easily known by being so closely massed together. Besides, they are almost in a direct line from Sirius, through Orion's belt. They are on the back of another constellation called *Taurus*, or the *Bull*.

That very large star on a right line, half way betwixt the Pleiades and the star that forms the western shoulder of Orion, is called the *Bull's eye*, or, *Aldebaran*.

That large star which, it may be perceived, forms a triangle of equal sides with Sirius and Orion's belt, is called *Procyon*, or the *Lesser Dog*. It lies to the north of Sirius, and to the east of Orion.

Imagine a straight line extending towards the north from Procyon, or the Lesser Dog, and the first star it meets with is *Castor*, or one of the constellation called *Twins*, very near which is another bright star called *Pollux*, the second of the Twins. This lies south-east with regard to Castor.

Those four stars that lie in a right line, at equal distances, and about half way betwixt the east shoulder of Orion and the Twins, are the *four feet* of the Twins.

A line drawn from the bright star that forms the west foot of Orion, through the star in his western shoulder, leads to the next star, called the *southern horn of the Bull*. This star, and the west foot of Orion, are equally distant from his west shoulder.

The northern horn of the Bull is brighter than the southern; it lies on a straight line with the east shoulder of Orion and the southern horn of the Bull.

The ecliptic, or the annual course which the sun seems to take in the heavens, passes betwixt the two horns of the Bull.

A line prolonged from the west foot of Orion, through Procyon, or the Lesser Dog, leads to that very bright star called *Regulus*, or the *Lion's heart*, which lies east by north-east from Procyon, and at some distance from it.

A line drawn from the star in the middle of the Twins, through Regulus, will then pass beneath a square of bright stars near Regulus, which form the constellation called the *Lion*. The first bright star, lying east by north-east from Regulus, and almost as large as itself, is called the *Lion's tail*.

A line drawn from a bright star that lies half-way betwixt the feet of the Twins and their heads, towards a bright star that lies east, will pass through the *Crab*, which lies exactly half way betwixt the Twins and the Lion, remarkable by one bright star and a cloudy clump of small stars adjoining to it. This constellation is difficult to be remarked.

Suppose a line drawn through the Twins, north-west by north, it will touch a bright star in the helmet of the constellation called *Auriga*, which is at a considerable distance.

A very conspicuous star lies south-west by south from this one. This beautiful star is called the *Goat*; and due east, opposite to it, lies another, which, with three or four more near them, situate to the south, forms the whole constellation called *Auriga*.

A line drawn from Procyon, by Aldebaran, westward, leads to the constellation called *Aries*, or the *Ram*. This is reckoned the first constellation in the heavenly order, since the mass of stars that form its head lie nearest that point where the sun equally divides the year, making the nights equal to the days. The first star in the Ram's horn, which is the star astronomers reckon from, lies thirty-six degrees more to the west than Aldebaran.

Imagine a line drawn from the Seven Stars, or the Pleiades, north north-west, and the first star it meets is the first star in the *breast of Perseus*; the star to the north-west of this is his right shoulder, the star to the west is the left, and the very brilliant star, south by south-west of the breast of Perseus, is the first star in the constellation called *Medusa's head;* next to which there are three others very near, that form the whole head, something in the form of a square.

The very bright and beautiful star, lying east by north-east from the Lion's tail, is *Arcturus*, the largest in the constellation called *Bootes*, situate between his legs.

The mass of stars west by north-west of Arcturus, between it and the Lion's tail, is called *Berenice's lock*.

A line drawn from Arcturus, north by north-west, falls in with the last star of the tail of the capital constellation called the *Great Bear*. This last is formed

Fixed stars.

by seven stars, in the form of a plough. It is the most conspicuous constellation in the heavens, and, therefore, may serve to point out others. Of this constellation the four stars that lie towards the north form an irregular square, of which the two stars that are the most northern, point northward to a bright star, not very distant, which is called the *Pole-star*, as it lies only about two degrees from the pole of the world.

The *Swan* is a very remarkable constellation, in the form of a great cross. A line drawn from the Twins, through the Pole-star, meets the Swan on the north side, at nearly the same distance.

A line drawn from the northern side of the square of the Great Bear, through the pole, passes through the middle of the constellation of *Pegasus*. This, too, is a square formed by four bright stars, the most northern of which forms the head of *Andromeda*. A line carried from the Pleiades to the Ram, falls upon *Algenib*, the beautiful star in the wing of Pegasus. The most northern stars of Pegasus are called *Scheat* and *Markab*; Scheat lies to the north, and Markab to the south.

Cassiopeia is a constellation directly opposite to the Great Bear, through the Pole-star, in such a manner that the line that passes through the middle of the Great Bear, by the Polar-star, passes also through Cassiopeia on the other side of the pole. This constellation is formed of six or seven stars, in the shape of a chair turned upside down.

Cepheus is that constellation contained betwixt the Polar-star, Cassiopeia, and the Swan. A line drawn from the Pole-star to the Swan's tail, passes through the two first great stars in the constellation of Cepheus.

The *Lesser Bear* has almost the same shape as the greater, and is parallel to it, but the situation is inverted. The Polar-star is the last in its tail. The two largest stars in this constellation are in a line drawn through the centre of the square of the Great Bear, perpendicular to both its greater sides.

The *Dragon's tail* lies betwixt the Polar-star and the square of the Great Bear. The four stars in its head lie south by south-east with regard to the Lesser Bear, and almost form an exact square.

Such are the positions of the most conspicuous stars which appear to us in a winter night. The others may be known either by means of a *celestial globe*, which is an exact image of the great sphere of the heavens, or by *celestial maps*, or *catalogues of the stars*.

PART II. ASTRONOMY IN ITS IMPROVED STATE.

The great object of astronomy is to discover the nature of the power by which the heavenly bodies are kept continually in motion. Like every other species of knowledge, this can only be attained by studying the effects of that power; namely, the motions themselves, and carefully comparing them one with another.

In Part I. we have considered the nature of these motions as far as can be collected almost by mere inspection; and though, even in this manner, our notions have become considerably more correct than at first,—though we have thus found that the earth, instead of being an immense plain, extending to the heavens, is a round mass of matter, insulated in space, and separated from the stars by a distance to which even its own great magnitude bears no sort of proportion—though we have found that the sun, the moon, and the planets, the two former at different distances from the earth, and all of them probably nearer us than the stars—have motions peculiar to themselves, while at the same time they all participate in the diurnal motion of the stars—we are still left completely in the dark as to any great principle to connect these complicated phenomena together.

Astronomy, therefore, could hardly ever have advanced beyond its infancy, with this rude instrument of observation. To obtain a more perfect knowledge of the phenomena, and of their causes, it was necessary to compare them together in a much more accurate manner, and to substitute for inspection the more refined process of *measurement*. It is accordingly by this happy application of *instruments* to aid the imperfection of our senses, that astronomy has been brought to its present state of improvement. To make the subject, however, in the least degree intelligible in this view, it is absolutely necessary that we explain, and we shall do so as shortly and as distinctly as possible, the general principles upon which these measurements are affected.

Chap. I. Measurement of Quantities in Astronomy.

Sect. I. *Quantities which occur in Astronomy.*

Force.—The forces, as we have already observed, which animate the heavenly bodies are the ultimate objects of the astronomers researches. "The nature," says La Place, "of that singular modification, by virtue of which a body is transported from one place to another, is and will always be to us unknown. It has been termed *Force*; but its effects, and the law of its action, is all that we can possibly determine."

Space and Time.—In putting a body into motion, force is distinguished by two distinct effects—one by which it makes the body describe *space*, the other by which it makes it describe *time*. A body in motion is not only transported through successive portions of space, but also through successive portions of time. Thus, when a stone is thrown into the air, not only does it continually rise higher and higher, and then descend in the same manner, but in each part of its course, from its projection to its greatest elevation, and thence to its fall; it marks out and carries as inseparably along with it to the mind the idea of successive intervals of time.

In estimating the intensities of forces acting with various effect upon the same moving body, these two quantities, space and time, are the only elements which enter into the calculation. A person, for example, is in the daily habit of observing a mail coach

Of quantities.

pass by his house, and being surprised one day at the uncommonly exhausted state of the horses, finds, upon inquiry, that they had started at the usual hour, but owing to an accident had been obliged to run a part of the preceding stage, that they had therefore run over a greater *space* than usual in the same time. Upon this his surprise immediately ceases, as the cause seems quite adequate to the effect. On remarking the same circumstance another day, he is again satisfied, on being informed, that the coach was later than usual in setting out; that the horses, therefore, had run their course in much shorter *time* than usual. The intensity of a force then depends neither entirely upon the space over which, nor upon the time during which the body moves, but upon the mutual relation of those two quantities.

Velocity.—This relation is denoted by the term velocity; it is the space which a body describes in a given time; the number of feet, for example, which it passes over in a second, in a minute, or in an hour. Thus, a person on horseback, is said to go quicker,—to have a greater velocity than a person on foot, because he moves over a greater space in the same time. When no time is mentioned, a second is always understood; and in this view, the velocity of a body is nothing more than the space which it describes in a second.

The problem of the forces which animate the heavenly bodies being thus reduced to the discovery of their velocities, the question of their successive positions, both in point of space and in point of time, by which their velocities are determined, becomes in the first instance the great object of inquiry. These are the quantities which the astronomer is almost constantly occupied in observing; the whole efforts of the artist being in the mean time directed to the invention and improvement of the instruments by which they can be most precisely measured; and and the whole efforts of the mathematician to the discovery of methods of calculation that may enable him to determine the conclusions to which the observed velocities would lead,—the nature of the forces which they would indicate.

Sect. II. *Measurement of Space.*

Space, or distance, as we have already seen, is of two kinds, linear and angular. Linear distance is measured by selecting any portion of it, as a standard with which every other may be compared. But as there is no body in nature which is always of the same extent, this selection is quite arbitrary. In this country the standard measure of distance is the foot; by its continued repetitions, we express larger distances, as miles—and smaller ones by its continued subdivision into inches, tenths, &c. When the objects whose distance is required are accessible, it is measured by the actual repetitions of the standard, but it is only by combining their angular with their linear distance, that we can discover that of inaccessible objects; and this being the case with all the heavenly bodies, it is hence in the measurement of angular distance that the astronomer is principally concerned.

Measurement of angles.—The whole circuit is here, as we have already seen, a fixed standard of comparison. Its parts may be measured by any line, A E, Plate 22. Fig. 6. drawn across the lines which contain the angles. Being cut by the diverging lines a B, a C, a D, its sections, A B, A C, A D, would evidently indicate the comparative magnitude of the angles A a B, A a C, A a D, &c. as well as that of the angles B a C, C a D, &c. by the parts B C, C D. But as it is only (p. 482.) when an object revolves round a point, that it exhibits all the degrees of angular extent, in the same manner it is only some line which re-enters into itself, by whose division into parts we can compare one angle with another. For unless the direction of A E were changed, it would evidently fail in the case of the right angle A a F, as the line A F, being parallel to A E, would never cut it. Besides this, the sections A B, B C, of the line A E, corresponding to the *equal* angles A a B, B a C, &c. have the inconvenience of being *unequal.*

Now, of all re-entering lines, the circumference of the circle is the only one which, being cut by lines diverging from the centre, has the property of making equal angles correspond to its equal sections, and as it thus affords peculiar facilities for minute subdivision is has become, in fine instruments, the universal scale for the measurement of angles. Its division into parts is quite arbitrary, though its quarter, the measure of the right angle (p. 482.) seems naturally the first subdivision. There are only two systems of division, the *sexagesimal* and the *decimal* divisions, that have ever been much adopted; and of these the latter, having been only of late introduced by the French astronomers, is much less extensively used than the former, though recommended by its coincidence with the decimal scale of our arithmetic.

The radius a A (Fig. 7.) of a circle goes exactly six times round the circumference, dividing it in this manner into six equal parts, A B, B C, &c. and hence the sexageximal division has probably arisen. In this division each sixth part, A B, B C, is subdivided into sixty smaller portions, called *degrees*, of which the whole circumference, therefore, contains six times sixty, or 360; each degree is again divided into sixty equal parts called *minutes*, and each minute again into sixty *seconds*. These subdivisions are marked by the following characters: Degrees°, minutes′, seconds″: Thus 10° 15′ 20″, denote 10 degrees, 15 minutes, and 20 seconds; each second is less than the millionth part of the circumference; but to this extreme degree of minuteness has the refinement of modern art succeeded in measuring angular extent.

The principle of all angular instruments is the same. In their rudest state, they consist each of a circle, or portion of a circle, A B C, Fig. 8. the circumference of which is divided into degrees, minutes, &c. It has attached to it a piece A C, termed its *index*, moveable round its centre O, and extending to the circumference, which being directed first to one object P, and then to another Q, the circle itself remaining all the while fixed, indicates by the interval A B, between the two positions upon the circumference, to which it successively arrives, the angular distance of the two objects—the number of degrees, minutes, &c. contained in the angle P O Q.

The larger the circle A B C is, the greater is the accuracy of the observations. The ancient astronomers accordingly employed instruments of great size;

Of quantities

to make the index also point more directly upon the object, they used two *sights*, or two upright pieces. A B, Fig. 9, fixed at the extremities of the index, and pierced each with a small hole or slit, through which the objects were observed.

In modern times methods have been invented for subdividing the degrees without enlarging the circle. The admirable discovery also of the magnifying power of lenses, by its application to read off the divisions of our instruments, admits their being reduced to a still more commodious form; while it carries them, perhaps, to their utmost perfection, by substituting, for the rude observation of sights, the astonishing power of the *telescope*.

Sect. III. *Measurement of Time.*

Time is measured upon the same principle as space, namely, by the repetitions of a certain portion of it indicated by an event. In both cases the accuracy of the process depends evidently upon the dimensions of the unit remaining unvaried in all its repetitions. Heat and moisture are the only circumstances which have been found to affect the extent of bodies. The varying causes of the duration of events are much more numerous and less easily estimated. The measurement of time is, accordingly, a problem of the highest practical difficulty.

Year, day, month.—The heavenly bodies seem designed by nature for effecting this important purpose to mankind. Their motions furnish a succession of similar events, sufficiently obvious and minute for all the purposes of uncivilised life; and they have also been found to surpass in uniformity the utmost refinements of art. Those of the sun are the most striking and most remarkably distinguished by their connection with the labours of man and the operations of nature. The *year*, the period of his variations, has accordingly been universally adopted as the standard of comparison. His successive appearances above the horizon mark its subdivision into *days*, and the changes of the moon produce the intermediate period of the *month*.

Time-piece.—The purposes of an improved society, however, require divisions of time still more minute, and the whole process to be brought, if possible, into the commodious form of an *instrument*, whose indications can easily be observed. To the astronomer, also, it is of the utmost importance to obtain a measure of time, independent of the heavenly motions; for, being previously ignorant of the causes of the sun's motions, he is quite uncertain whether or not the successive events which they mark out are performed under the very same circumstances; whether, therefore, the days of the year, or the years of a century, are each of the same duration. Time, in short, being one of the elements whose knowledge is absolutely necessary for the discovery of these causes, it is equally indispensible that he possess a method of measuring it in some degree independent of the motions.

The principle of all time-pieces is the same. The great object in them all is to produce an invariable motion, so that the moving body may present, by the successive spaces which it describes, a constant succession of similar events; and thus indicate equal portions of time by the graduations of the space to which it successively arrives. This is precisely what is done in our clocks and watches, whose indices or hands are bodies of this description moving over the divisions of the dial-plate. A motion of this kind, by which a body describes equal spaces in equal times, is said to be *uniform*; and though any other motion would equally answer the purpose, if its variations were regulated by a constant law, uniform motion has the convenience of admitting the dial-plate to be divided into equal portions; revolving motion has also the obvious advantage of describing, and the circumference of the circle of measuring any extent of angular within the smallest compass of linear extent, and thus allowing the instruments the most commodious form that other things will permit. It is on this account that the uniform motion of a body upon the circumference of a circle has become universally the form of our time-pieces.

These instruments have only been brought to perfection by long-continued observation and experience. By comparing those of one construction with those of another, and all of them with the motions of the heavenly bodies, the circumstances which derange their uniformity have been gradually brought to light and corrected; and it has been found, that the more these deranging causes are obviated, their motions are only approaching nearer and nearer to those of the celestial sphere,—that their hands are only presenting a more and more perfect image of the revolutions of a star. It is by this standard of perfect uniformity, then, that the astronomer corrects the unavoidable inequalities of his clocks.

Sect. IV. *Positions in Space.*

Let us now consider the method of determining positions in space. The position of an object in space is that particular position of space which it occupies. Thus one it said to be in the middle of a room when he is equally distant from its opposite sides; and he is in the east or west end of it according as he approaches its eastern or western side.

It is plain that the position of an object, O, on the floor of the room A B C D, is not completely determined by its distance O G from either of its sides A B, or by O E, its distance from its end A D; for there are various other points, 1, 2, 3, &c. namely, all those in the line E O F, parallel to A B, which are at the same distance O G from A B; in the same manner as in a book there is a number of lines all in one page; and when we wish to refer to any particular sentence, as we must then tell the line as well as the page, so, in order to define the particular point O, we must also know its distance O E from A D, the end of the room. By knowing its distance from A B, the side, we only know the line E O F in some part of which it is situated; but by knowing besides its distance from A D, we get another line G O H, in which it is also somewhere to be found; as it is therefore both in E O F and in G O H, it must necessarily be the point O where these lines meet, and which is the only one that can be in both of them at once.

It is evident also, that any *other* two lines, $e\,O\,f$, $g\,O\,h$, passing through the point O, would, by their intersection, equally well determine its position; and even

Of quantities though they were not straight, but circular or curved in any other manner, as e f, g h, they would still only meet in a single point, and thus indicate its position. In general, then, when we know the *surface* (the floor of the room in this example) on which a body is situated, its position on that surface is completely determined by the intersection of *any two lines;* and it is therefore completely known (or *given*, as it is termed) when we know the positions of these lines.

When the position of objects is to be ascertained by actual observation, we must take those lines to determine it by their intersection whose position can be most easily measured. A spectator at A, for example, (Fig. 11.) wishes to know his distance from a house, H, beyond the lake L; he sets up a signal at B, measures with a chain the distance A B, suppose 1000 feet, termed *the base line*, and setting his angular instrument at A, measures with precision the angle B A H, and thus obtains the position of the line A H, upon which H is somewhere situated. Transporting his instrument to B, he measures in the same manner the angle A B H, and thus obtains the position of another line in which the house is also situated. These observations, therefore, afford the means of finding the point of intersection of the two lines, or the distance B H.

When there is a variety of objects, however, all whose positions are to be determined and enumerated, such as the stars, or the places upon the earth, or as 1, 2, 3, &c. Fig. 12, in order to bestow uniformity upon the expressions of these positions, it has been found convenient to reduce them all to a common standard; and when their positions are once determined by the intersection of those lines, to which the nature of the operation necessarily limits us, as they can then be easily expressed by that of any other lines chosen at pleasure, it has been universally agreed to fix upon some two lines, A B, C D, at right angles to each other, (and analogous to the sides of the room in our example,) and to express the positions of all the objects by their distances from them, 1 *a*, 1 a, &c. 2 a, 2 *a*, &c. to which a generic name, as *latitude, longitude*, &c. &c. is applied.

We have hitherto supposed the objects all situated upon a plane surface; but what has been said will also apply though the surface be spherical or any how curved, only the lines which in that case determine the positions of the points upon it will also have a corresponding curvature. But the heavenly bodies seem all at the surface of a sphere, and the surface of the earth is also spherical. Astronomers have accordingly agreed to use certain circles of these spheres, to whose position that of the points on their surfaces may be referred. These circles we shall now shortly describe.

Sect. V. *Positions in the Heavens.*

Circles of the sphere.—Every circle of a sphere may be conceived to be formed from what is termed the *section* of the sphere by a plane. Let any globe, for example, be cut in two by a plane, that is, by a body of any length and breadth, but as thin as can be imagined; and let the parts be re-united; the mark or curve which now appears upon the surface of the globe, all along the joining, is a circle, and is called the section of the sphere by that plane, and its position is indicated by that of the plane, which is termed *the plane of the circle.* When the sphere is cleft through the middle into two hemispheres, the plane then passing through the centre of the sphere, the circle, which is formed on the surface by this section is termed a *great* circle of the sphere. In every other case, that is, when the plane of a circle does not pass through the centre, it is termed a *small* circle. Of quantities

These circles, which arise from the actual section of a spherical body, by another flat body nearly deprived of its thickness, must be extended in idea to the sphere of the heavens, in order to have a correct notion of the circles which have been imagined for the purpose of determining positions upon its surface. But it must never be forgotten, that as that sphere has really no existence, neither have these curves, of which astronomers make so frequent mention. They are merely the circles that *would be* formed were the sphere a material substance, and were it intersected by actual planes, as we conceive it to be by imaginary ones.

Zenith.—The point of the heavens most easily recognised is that directly over our heads, or the *zenith.* It is sometimes difficult to recognise the north and the south, but the zenith is obvious to every one, and in every place. It is indicated with more precision by the direction of *a plumb-line*, and is the point in which the latter would meet the celestial sphere, being sufficiently prolonged above.

Vertical.—The line which joins the zenith and the observer, is termed *a vertical.*

Nadir.—That point under our feet in which it would meet the sphere by its prolongation below, is called the *nadir.*

Plane of the horizon.—If a plane be conceived to pass through the eye of the spectator, perpendicular to the vertical, this is called the *plane of the horizon*, and the circle which it forms on the sphere, by its prolongation on all sides,—the section of the sphere by this plane, is termed the *horizon.* It is the circle which separates to a spectator his visible from his invisible portion of the heavens,—the boundary of our prospect, as we have hitherto merely considered it. It is one of those circles to which the positions of the heavenly bodies are referred. But if it be merely a conception, it is not easy perhaps to see how it can serve as a point of reference. This will be understood, if we shew how its position can always be determined; it is always indicated by looking along the surface of the ocean, or any plane surface, as a board or a table, set perpendicular to the plumb-line. Angular instruments are accordingly fitted with a plumb-line, or, which answers the same purpose, a *spirit level*, by means of which the line of the telescope can be set with great precision in the plane of the horizon, and the angular deviation of the stars from this plane measured with equal nicety, the instrument being so constructed as to move from the right to the left, or the contrary, all round. The horizon, in this view, is nothing else than the imaginary union of that series of points which we observe in the telescope, when it moves in the plane of the horizon,—when it moves

Of quantities round with the bubble of the *spirit level*, always in the middle of the glass, or the line of the telescope, always 90° from that of the plummet.

Verticals.—Conceive now a series of planes, Z A B N B′ A′, Z a b N a′, Z *a b* N *a′*, &c. Fig. 13. all passing through the vertical of a place; or conceive a single plane to assume those various positions by revolving upon the vertical as an axis: these are called *vertical planes*; being prolonged on all sides towards the heavens, they cut the sphere in the circles Z H N O, Z h N, Z *h* N, &c. Fig. 14. which are termed *vertical circles*, or simply *verticals*; they are those circles which the eye traces in the heavens, by looking along a plane board set up in the direction of the plummet. The telescopes of angular instruments are made to move in a vertical by means of the plummet, or spirit-level, while they can be made to describe any vertical whatever by means of the horizontal movement above mentioned. All the vertical planes, along with their line of common section, are perpendicular to the plane of the horizon, and the great circles themselves are also perpendicular to the horizon; they form with it what are called *spherical angles*, Z H h, z h *h*, &c. and each of them is 90°, being always equal to the angles of their planes.

Altitude.—The position of a star, S, will evidently be determined when we know the vertical, Z *h* N, in which it is, and its distance from the horizon, S *h*,—the arc of the vertical intercepted between it and the horizon, H O; for there can be only one point of the same vertical at the same distance above the horizon. The distance is called the *altitude*, or elevation of the star. It is the angle, S E H, which the line joining the star and the centre of the earth, E, or the observer, z, makes with the plane of the horizon, (the line, E z, being considered as of no magnitude relatively to the distance of the star,) and is measured by the degrees, minutes, &c. in the arc of the vertical, S *h*, between the star and the horizon. It is actually observed by making the index of the vertical circle of the instrument point to *Zero*, or 0° 0′ 0″, when the line of the telescope is in the plane of the horizon, and then elevating it till the star appears exactly in its centre, which is indicated by two cross wires; the index now points out the elevation.

Meridian.—It only remains then to define the vertical in which the star is; and for this purpose some vertical must be selected, to whose position that of all the rest may be referred,—from which their distances may be estimated. Now, of all the verticals, that one, Z H N O, which is called the *meridian*, and which passes through the poles of the sphere, P p, is the most remarkable. The planes of them all pass through the zenith, Z, through the eye of the spectator, z, and through the centre of the earth, E; but that of one only, Z p O P, has the property of passing also through the two celestial poles, or through the axis, P p, of the sphere. This is the plane of the meridian. It is distinguished from every other vertical plane by another important circumstance. The diurnal circles, l m n, 1 *h* 2, which the stars describe, have their planes parallel to each other, and perpendicular to the axis of the sphere, P p. They are in general termed *parallels*; and that one, e E q, which also passes through the centre of the earth, is termed, as we have already seen, the *equator*, being equally distant from both the poles. The plane of the meridian, as it passes through the vertical, Z N, is perpendicular to the horizon, H O; and as it also passes through the celestial axis, it is also perpendicular to the equator, e E q, and to all the parallels, l m n, 1 *h* 2. From this peculiar position of these circles relatively to each other, the meridian divides into two equal parts that portion of each parallel which is above the horizon, as well as that portion of each which is below it, one half only of each of these halves being seen in the figure, l m 1 *h*. The instant, therefore, the sun passes it above the horizon it is *mid-day*, from which circumstance it derives its name—he has then attained his greatest elevation; and the instant he passes it below the horizon it is *mid-night*. It is the same with the stars; they all come to the meridian, and to their greatest elevation, at the middle of the interval between their rising and setting; and as to those stars which, from their proximity to the pole, never reach the horizon, but describe whole circles, *S S′*, s s′, above it, passing the meridian both above, at *S* s, and below the poles, at S′s′, the meridian divides these circles into two equal parts.

Transits.—Thus, for every one of the heavenly bodies, without exception, the instant of the passage, or *transit* as it is called, is that of the greatest altitude; and for those stars which pass the meridian both above and below the pole, it is the instant of their greatest altitude in the one case, and the least in the other.

Meridian line.—The position of the meridian is indicated by that of the sun at noon. It is more accurately determined by observations of his altitude, or that of a star, before and after passing the meridian. Observe with an instrument the altitude of a star some time before its passage over the meridian, and mark the vertical in which it then is. In descending, after its transit, the star will again arrive at the same distance from the horizon which was noted in its ascent. Its progress must, therefore, be carefully watched, in order to mark the vertical in which it is situated when this happens. The direction of the meridian is intermediate between that of the two verticals; and if a staff be set up in this direction it will mark out what is termed a *meridian line*. The east and west are the directions, each 90° from the former.

Azimuths.—It is from the meridian, then, the *prime* vertical, that the distances from the other verticals are reckoned. They are termed in general *azimuths*. The azimuth of a star, S, is the angle, H Z *h*, that the vertical plane in which it is situated makes with the plane of the meridian, the prime vertical; and is measured by the arc of the horizon, H *h*, intercepted between the point H, in which the meridian cuts the horizon, and the point *h*, in which the vertical Z S *h* cuts it. The azimuth then determines the vertical in which the star is, and its altitude, its position upon that vertical; and thus its situation, S, upon the sphere is completely ascertained.

Sometimes also the vertical Z E N, which is perpendicular to the meridian, and lies due east and west, is termed the *prime* vertical, and the position of a star's vertical, indicated by its distance from it, E *h*, which is termed its *amplitude*.

Celestial meridians.—But as the verticals and the

Of quantities

horizon change their position with that of the observer, the position of every star, were it indicated relatively to these circles, would have the inconvenience of being expressed by a different quantity for every different position upon the globe. These positions, therefore, are only useful as they are connected with, and afford the means, of determining those of the stars relatively to another and a similar system of circles, quite independent of our position upon the earth. In the latter, the axis of the celestial sphere, P p, Fig. 15. corresponds to the vertical, Z N, Fig. 14. in the former. A series of circles, Z H N O P, P e p, P e p, Fig. 15. whose planes pass through this axis, and which are called in general *celestial meridians*, correspond to the verticals, Z H N, &c. Fig. 14. The equator, E Q, Fig. 15. to which they are all perpendicular, is analogous to the horizon, H O, Fig. 14. and the meridian of the place is at once a vertical and a celestial meridian. It is that vertical, Z H N O, Fig. 14. whose plane passes through the axis of the sphere, and that meridian, P E p Q, Fig. 15. whose plane passes through the vertical of the plane, Z N.

The position of a star, S, relatively to this system of circles, is determined in the same manner, when we know the meridian, P e p, in which it is, and its distance, S e, from the equator, which gives the parallel, S O, in which it is. These are the two lines at whose point of intersection it is situated.

Position of the equator.—It is, first of all, necessary then to determine the position of the plane of the equator. This is done by finding that of the axis of the sphere, P p, to which that plane is perpendicular, and which is indicated by the position of the north pole, P. The pole being in the meridian, its position is determined by its altitude, O P. This could be easily measured, were there a star situated in the stationary point, P. There is none exactly so situated; the pole-star, however, describes a circle round it, at the distance of 2°, and the rest, *S*, s, at greater distances. The pole, then, the common centre of all these circles, must be situated half-way between the positions, s, s′, of any star when crossing the meridian, the one above, and the other below the pole, and must therefore have an altitude intermediate between the greatest, O s, and least altitude, O s′, of the star.

Altitude of the pole.—We have only, then, to fix upon a star which never sets, and observe its extreme altitudes, the one when it passes the meridian above, and the other when it passes it below the pole. The mean, that is half the sum of the greatest and least altitudes, is the altitude of the pole. If the instrument is not provided with a telescope for observing the stars through the day, these observations can only be made in winter, when the night being longer than the day, a star can be seen during more than one-half of its revolution.

The position of the pole being thus determined, the line joining it to the eye of the spectator is the axis of the sphere, and the plane of the equator is determined to a nearness by setting up a plane surface or board perpendicular to this axis. By looking along this board the eye will be directed to the celestial equator, the circle in which this plane, produced on all sides, would cut the sphere; and on the 22d of March and September, the sun, then describing this circle by the diurnal rotation, will be seen during the whole day in the direction of the board.

To obtain greater accuracy it must be observed, that the altitude of the pole, O P, together with the altitude of the equator, H Q, just amount to 90° (inasmuch as they are the two portions, O P, H Q, of the whole semicircle (180°) of the meridian, O P Q H, which remain after taking away the portion, P Q, between the pole and the equator, which measures the right angle Q e P.) They are each, therefore, what the other wants of 90°. They are the *complements* of each other, as this relation is termed. By taking the altitude of the pole, then, from 90°, the remainder is that of the plane of the equator; and the telescope of the instrument being set in the meridian to this altitude, will indicate the point in which the equator cuts it. The points due east and west are those in which it cuts the horizon, because it is perpendicular to the meridian; and thus the situation of this circle is completely ascertained by these three points.

Declination.—The distance, S *e*, of a star from the equator, or the distance of the parallel in which it is, is termed its *declination*. It is analogous to its altitude in the former system of circles; and as the meridian is common to both these systems, and thus measures both declination and altitude, the declination of a star is hence connected by a very simple relation with its meridian or greatest altitude. It is evidently the difference, *s* Q, or *s′* Q, between the meridian altitude *s* H, and the altitude of the equator, Q H, the complement of the altitude of the pole, and is north or south according as the star is north or south of the equator, or according as the meridian altitude is greater or less than the co-latitude of the pole. The declinations of the stars, then, are determined by measuring their altitudes when on the meridian.

To define, now, the meridian in which the star is, it is necessary, as before, to fix upon some one to form the zero of the scale, from whose positions that of all the rest may be reckoned, as the horizon, H O, Fig 14. is the zero of the scale of altitudes, the meridian, Z H, of azimuths, and the equator, E Q, Fig. 15. of declinations.

Equinoxes.—Right ascension.—Now we have seen that the ecliptic, the circle which the sun annually describes, crosses the equator at a certain obliquity; the intersection of these two circles mark two positions which can always be recognised in the heavens; they are called the equinoxes, because the sun being then in the equator, makes the days equal to the night all over the world. The line which joins them passes through the centre of the earth, and is called the *line of the equinoxes*. The sun is in the one, in the spring, on the 22d of March, and in the other, in Autumn, on the 22d of September. These are the days of the equinoxes, the former of the vernal, the latter of the autumnal equinoxes. It is that meridian which passes through the equinox of spring which has been selected to reckon the distance of the rest from; it is termed the *prime meridian*, and is represented in Fig. 15. by P Q p. The planes of all the meridians pass through the axis of the sphere, P p; that of the prime meridian is distinguished by also passing through the line of the equinoxes. The distance of the meri-

Of quantities dian, P S e, in which a star is from the prime meridian P Q, is termed its *right ascension*. It is the angle which the plane of the star's meridian, P e p, makes with the plane of the prime meridian, P Q p E, and is measured by the arc of the equator, Q e, comprehended between the prime meridian and the star's meridian—between the vernal equinox, the point in which the prime meridian cuts the equator, and the point, e, in which the star's meridian cuts the equator.

The situation of the prime vertical is always fixed for the same point of the globe; the prime meridian is continually moving along with the rest of the meridians, by the effect of the diurnal motion of the sphere; its position, as well as their right ascensions, is therefore not so easily determined, and it is here that the astronomer discovers the inestimable value of the time-piece, as an instrument for finding positions in space. The position of bodies which are at rest is determined by their distance from other bodies; but bodies in motion, as we have seen, describe time as well as space, some in a regular, and some in a very irregular manner. When the motion of a body is uniform, or its velocity is the same in every part of its course, it moves over the same number of feet every second of time. If we once knew this velocity, therefore, it would be easy, by observing the elapsed time upon the clock, to determine the distance of the body from the point at which it set out.

It is upon this principle that the astronomer measures the right ascensions of the stars. Their motion has been discovered to be perfectly uniform, or at any rate to excel that of the nicest instruments. Its rate is easily recognised by observing the transits of the stars over the meridian. These observations are made with what is termed a *transit* instrument. It is a telescope constructed to move with great precision in the plane of the meridian, and having in its field of view one or more fine wires parallel to the meridian, and equally distant from each other. The instant of the transit is marked by the instant of the stars covering the middle wire, or by the interval between the instants of its covering the extreme ones. The interval between two successive transits of the same star is termed a *sidereal* day; it is the period of the stars making a complete circuit in the heavens, and the astronomical, or *sidereal* clock, as it is termed, is so constructed, that the hour hand makes a complete revolution in the same time; so that if a star passes the meridian to-night when the clock indicates, for example, $0^h, 0^m, 0^s$, it will indicate exactly $0^h, 0^m, 0^s$, as the instant of the transit to-morrow night. The hand of the clock thus describing the same angle with the star in the same time, forms a reduced image of the star's diurnal motion, resembling it in every thing but the scale. Suppose, now, that the clock indicates $0^h, 0^m, 0^s$, for the instant of the transit of the star which is situated in the prime meridian, not only will it also indicate $0^h, 0^m, 0^s$, for the instant of its succeeding transit, so that by looking through the telescope at that time, we expect to find the star covering the centre wire with nearly as much certainty as the rising of the sun,—not only is this single position of the star indicated by the clock, but each new position which it assumes in advancing from the meridian towards the west, is indicated by the corresponding position of the hand as it advances from the origin of its scale, $0^h, 0^m, 0^s$. The interval of time from 0^h will thus indicate the distance of the prime meridian from the meridian of the plane, and for every star, the instant of its transit over the meridian of the place will indicate its right ascension,—the angular distance of the star's meridian from the prime meridian. But the angle which the star describes in a day, namely the complete circuit, is divided into 360^0, each degree into $60'$ &c. while the divisions of the circuit which the hand of the clock describes are fifteen times larger, the circumference being only divided into 24 hours, each hour into 60 minutes, &c. The arcs of the right ascension then, will be expressed in time by a quantity just fifteen times less than when expressed, as usual, by degrees of the equator. But whether the right ascension of the star be expressed in time or in angular distance, it is still the same quantity,—the angle between the planes of the prime meridian and the star's meridian; and it is the mere circumstance of time and angular magnitude which are both involved in the stars motion, being both measured by the portions of the circumference of a circle; it is the mere circumstance of these two quantities, apparently so heterogeneous in their nature, being still brought to a common measure, that enables us to express the right ascension by the one or the other indifferently.

To obtain the right ascensions of the heavenly bodies, then, it is first of all necessary that the clock move uniformly, for that is the point upon which the accuracy of the method entirely depends. Provided this condition be fulfilled, it is not of so much consequence its going a little faster or a little slower than the star, for this can easily be allowed for.

Position of the equinox.—The next thing to be determined is, the position of the prime meridian, that the clock may be set to $0^h, 0^m, 0^s$, when it passes the meridian of the place. This could easily be observed, were there a star situated in the vernal equinox; there is none exactly so situated, but the sun is in this point once a year, and would therefore answer the purpose were he at the same instant on the meridian. This, however, seldom happens, and it is only by an indirect process that we obtain the object in question. When the sun is in the equator, his meridian altitude being then the same with that of the equator, is evidently equal to the co-altitude of the pole or the co-latitude of the place. By observing his meridian altitude the day before and the day after his passing the equator, it is easy from these data to *compute* the time, suppose $3^h\ 40^m$, that elapses between his transit on the first day, and the instant of his crossing the equator, or the instant when his meridian altitude is exactly equal to the co-latitude of the place; the clock having been previously set to $0^h, 0^m, 0^s$, when a certain star, suppose west of the sun, comes to the meridian—the instant, suppose $6^h\ 10^m$ of the sun's transit the first day is also observed; this is the difference between the right ascension of the sun and that of the star; and adding it to the computed interval of $3^h\ 40^m$, their sum $9^h\ 50^m$, taken from 24^h, is the right ascension of the star, to which the clock must be set when the star

Of quantities

comes to the meridian, in order that it may indicate 0^h, 0^m, 0^s, when the prime meridian comes to the meridian. This process very well illustrates the nature of the prime meridian; it is not, as we have formerly observed, a real object, neither is its position indicated by any real object which we can at all times observe,—it is merely the imaginary and conventional origin from which all right ascensions are dated; it is only recognised in the spring by the sun's crossing the equator, and even the instant of this event we are frequently obliged to deduce from other observations.

Latitude and longitude.—There is still another set of circles to which the position of the heavenly bodies have been referred. The ecliptic, E C, Fig. 16. is here analogous to the equator and to the horizon in the above systems; an imaginary line, *P p*, perpendicular to the plane of the ecliptic passing through the centre of the earth, and meeting the sphere in two opposite points, *P*, *p*, corresponds to the axis of the sphere and to the vertical; it is the axis of the ecliptic; and a series of circles, *P* E *p* C, *P e p*, *P e p*, having this axis for the line of common section of their planes, correspond to the meridians and the verticals. These circles have received no particular name, except that of *secondaries* to the ecliptic, as the meridians are sometimes termed secondaries to the equator, and the verticals to the horizon. The points *P p*, in which the axis meets the sphere, are termed in like manner the *poles* of the ecliptic, as the poles of the sphere are sometimes termed the poles of the equator, and the zenith and nadir the poles of the horizon. The position of a star, S, is determined by that of the secondary to the ecliptic *P e p*, in which it is, and its distance *E e* on this secondary from the ecliptic. Its distance from the ecliptic is termed its *latitude;* and the distance, E*e*, of its secondary, from that which passes through the vernal equinox, is termed its *longitude;* it is the arc of the ecliptic comprehended between these two secondaries. The ecliptic has been (p. 489.) divided into twelve signs, each equal to 30°. In reckoning longitudes this division is used, and instead of saying a longitude of 30°, 45°, &c. we say 1 sign; 1 sign 15°,—or simply 1^s; $1^s\ 15^\circ$.

The latitudes and longitudes of stars are not observed; they are only computed from their right ascensions and declinations. The latter are determined, as we have seen, by observations of their meridian altitudes and their meridian transits. The meridian thus becomes the circle in which all astronomical observations are made. These observations are the source of all astronomical knowledge; and the transit instrument and astronomical quadrant for measuring altitudes, which is even sometimes united with the former, these, together with the clock, are the chief instruments of the practical astronomer, "the capital furniture of an observatory."

SECT. VI. *Positions on the Earth.*

For the purpose of determining the positions of places upon the earth's surface, a set of circles have been imagined quite analogous to one of those systems which we have described in the heavens. The axis, P p, Fig. 15. of the equator, which joins the two celestial poles, and passes through the centre of the earth, meets its surface in two points, P′, p′, opposite to each other. These are called the *terrestrial poles*, or *the poles of the earth.* The north terrestrial being next to the north celestial pole and the south to the south. The line P′ p′, which joins them, is also termed the *axis of the earth;* it is that portion of the axis of the sphere comprehended within the earth's surface. The planes of the celestial meridians, which all meet in the celestial and terrestrial axis, must in like manner meet the earth's surface, and their sections of it will be perfect circles if the earth be a perfect sphere, which we shall here suppose; they are termed *terrestrial meridians*; they are the circles P′ Q′ p′, P′ e′ p′, P′ c′ p′, &c. Fig. 15. or Fig. 17. diverging from the poles P′ p′, which a series of planes passing through the earth's axis would form upon its surface,—the lines according to which they would meet it. The plane of the celestial equator E Q, in passing through the earth's centre, forms upon its surface a circle E′ Q′, termed the *terrestrial equator*, or by mariners the *line.* It is the line according to which a plane passing through the earth's centre, and perpendicular to its axis, would meet its surface.

Of quantities

Parallels.—Lastly, there has been imagined a series of circles proceeding from the equator towards the poles, and having their planes parallel to that of the equator; they are analogous to the celestial parallels.

Tropics.—Four of the parallels are distinguished above the rest, namely two, T R, T′R′, Fig. 17. situated at the distance of $23\frac{1}{2}^\circ$ on each side of the equator, and other two, A C, A′C′, at the same distance from either pole; the two first being analogous to the celestial tropics, E T, C′T′, Fig. 16. are named accordingly, that which is in the southern hemisphere the tropic of Capricorn, and that in the northern the tropic of Cancer. The two circles near the poles are termed the *polar circles*, the northern being also termed the *arctic*, and the southern the *antarctic circle.* These four circles divide the earth into five compartments, or zones, A C P′, A C R T, R T T′R, R′T′ A′ C′, and A′ C′p′, which have received names from the climates by which they are distinguished; that between the two tropics, in the middle of which is the equator, being the hottest, is termed the *torrid zone*; those beyond the polar circles, where it is coldest, the *frigid zones*; and the intermediate belts, where the climate is equally the medium between these extremes, *the temperate zones.*

Latitude and longitude.—The position of a place, *P*′, Fig. 17. on the earth's surface, is determined in the same manner as that of a star, by two elements, the distance *P′ c′* of its parallel from the equator, and *c′* Q′, of its meridian P′ *c′* p′ from a first meridian P′ Q′ p′, fixed by convention to form the origin of the scale. The first is termed its *latitude*; it is the distance of the place from the equator,—the arc of the meridian comprehended between it and the equator; and the parallel circles are termed *parallels of latitude.* The second is termed its *longitude*; it is the arc of the equator comprehended between the meridian of the place and the first meridian,—the angular distance between the plane of the first meridian and that of the meridian of the place of which this arc is the measure. These terms are analogous, the one to the declination, the other to the right ascension, and must not be confounded with the latitude and longitude of a star. No meridian has been fixed upon for a universal first meridian. In this country the longitudes are reckoned from the meridian of London; in France from that of Paris; in Russia from that of Petersburgh, and so on.

The latitude of a place A, Fig. 20. being the angle A T e, or Z T E, contained between the vertical T A Z, and the plane of the equator T e E, is equal to the distance of the equator from the zenith E Z, which is also the complement of O P, the altitude of the pole. To find the latitude of a place, then, it is only necessary to measure the altitude of the pole by the method already described.

In the same manner the longitude of a place, A, Fig. 20. being the angle A P′ m′, between the plane of its terrestrial meridian P′ A p′ and that of the first meridian P, m′ p′, or between the plane of its celestial meridian P E p, and that of the celestial meridian of London P m p, may be measured by the arc m E of the celestial equator, contained between the two meridians, that is to say, the difference between their right ascensions, or the interval of time that elapses between the transit of a star over the one meridian and its transit over the other. If we knew, for example, to-night, the instant of a star's transit over the meridian at London, we could observe to-night the instant of its transit at Edinburgh, and the interval of time 12′ 48″, or 2° 12′, multiplying by 15 would be the longitude of Edinburgh, just as a person who knows at what hour the mail-coach leaves London, as well as its rate of travelling, can tell, by observing at what hour it reaches Edinburgh, the distance between the two cities, with this difference, that the rate of the star's travelling between the two meridians is infinitely more uniform than that of the coach between the two places.

It is upon this principle that depend all the methods which have been invented for discovering the longitude,—a problem so interesting to the navigator. Time is regulated all over the world by the successive arrivals of the sun at the meridian of the place, as he advances in his daily course from east to west; and as he can only be upon one meridian at a time, he can only arrive successively upon the meridians of different places, as a coach arrives successively and at different times at its different stages. The inhabitants of different places thus have their noon at different times, later and later than at London, as they are farther and farther towards the west; so that when it is noon at London, it is little more than half-past eleven at Dublin. At Philadelphia, 75° 13′ west, it is only seven o'clock in the morning; the sun may then only be rising at that city; and by setting a watch with the clock at London, it will be found, on crossing the Atlantic, to be five hours in advance of that of Philadelphia. The problem of the longitude is thus reduced to that of discovering the interval between the noon of London and the noon of the place, or in general the difference between the time reckoned at London and the time reckoned at the place. It is the great object of artists, accordingly, to produce time-pieces that may go with regularity, notwithstanding the motions of the vessel.

Distances of the heavenly bodies.—Such are the methods both of expressing and measuring the position of objects in the heavens and on the earth. But the heavenly bodies, as we have seen, are not all at the same distance from the earth; the moon is much nearer us than the sun; and the latter, probably, much nearer than the fixed stars. They are not, therefore, all upon the surface of a sphere, as we have supposed; and as the above methods only fix their angular positions, leaving their linear distance quite undetermined, as a star may clearly have the same right ascension and declination, whether it be at the distance of 10, 100, or any number of millions of miles;—this important element is still wanting to complete our knowledge of their positions in space.

This subject has interested astronomers in all ages; and they have endeavoured to discover these distances by all the methods which the progress of the science has successively indicated. But the principle of them all is the same as that by which we discover the distance of inaccessible terrestrial objects. To give greater accuracy to the operation, astronomers have contrived to take the semi-diameter of the earth itself, and even the earth's distance from the sun, as the *bases* of the triangles, the intersection of whose sides determines the distances of the stars. Thus, let E R, Fig. 18. be the earth's semi-diameter, and let the sun be at S; astronomers have contrived to measure the angle E R S, which gives at once E S R and the distance E S. This angle, E S R, is termed the sun's *parallax*; it is the angle which the earth's semi-diameter subtends at the sun. If the sun be in the horizon at the time of the observation, the angle E S R, which is then the greatest, is termed the sun's *horizontal parallax*. If S had been the moon, or any other heavenly body in the horizon, the angle E S R would then be its horizontal parallax, the angular magnitude under which the earth's semi-diameter would have appeared to a spectator at that body, and it is the angle of which the knowledge leads directly to that of the distance of the body. But in the cases of the sun, the moon, and most of the planets, which have all a sensible apparent diameter, the variation of their distances from the earth is obtained with great facility by measuring their apparent diameters, that is, the angles which their real diameters subtend at the earth, and which augment and diminish in proportion as the objects approach to or recede from the earth. Thus, at the earth, E, Fig. 19. the angle S E U is the apparent diameter of the sun, and must not be confounded with its real diameter S U, which is invariable, and of which the apparent diameter is only the angular magnitude. If the sun advances into the position *S U*, or s u, his apparent diameter increases to the angle *S E U* and s E u, which, in small angles, is proportional to the distance from E. By measuring this angle, then, which is done with great precision by an instrument for the purpose, termed *a micrometer*, the variation in the distances of the heavenly bodies is ascertained.

Refraction, &c.—After all the above observations for determining the positions of the heavenly bodies are

The earth. made, there still remain several corrections, which must be applied before the *true* places, as they are termed, can be ascertained. Various causes, some optical, and some real, such as what are termed *refraction*, *parallax*, *aberration*, &c. contribute to produce, in their apparent places, a slight deviation from those which they really occupy. For these derangements, though only amounting, in many cases, to a few seconds, and though it has required the highest refinements of art to discover their effects, and of science to discover their causes, the astronomer is nevertheless careful to make the necessary allowances before making use of his observations; and since an observed deviation, were it but a few seconds, in any of the heavenly bodies, from the position either in place or in time which his calculation would assign to it, becomes thus a thing to be accounted for, some idea may be obtained of the wonderful precision to which the knowledge of these positions has been carried. It is so great, indeed, that if a telescope be directed to-day to a determinate point of the heavens, we can tell, several years in advance, the day, the hour, the minute, and the second, in which almost any one of the heavenly bodies will come and place itself exactly in the centre of the telescope, and cover in it a thread finer than a hair. The errors of astronomical tables are actually comprised within the breadth of this thread.

CHAP. II. OF THE EARTH.

SECT. I. *Its Figure.*

We have already seen, that the regularity with which new stars make their appearance, shews the convexity of the earth to be pretty regular in that direction. A more correct knowledge of its figure will be obtained by actually measuring, with the precision of modern observations, the exact dimensions of the portions of the heavens which successively make their appearance as we advance a certain distance towards the north or south.

Oblateness.—Upon these principles, portions of the terrestrial meridian have been measured in various parts of the world, some of them with astonishing precision, and to the extent, in France, of 12°, or one 30th of the circumference; and the result indicates incontestibly, to the figure of the earth, like that of an orange, a degree of oblateness at the poles, and a protuberance at the equator; so that the axis of the polar diameter is to the equatorial diameter as the proportion of 319 to 320, and less by about 24 miles.

Variation of gravity on its surface.—The oblateness of the earth is also manifested by the diminution of gravity on the weight of bodies, as we advance from the centre of the earth. It has been found, that as we ascend to the tops of high mountains, the effect of gravity suffers a sensible diminution. This result could not be obtained by means of the most exact balance, as the intensity of the weights themselves are equally diminished with that of the bodies which we would weigh. It is only by experiments on the pendulum that these variations can be noticed. Its oscillations become slower, as gravity, the power which produces them, is diminished. In this manner the pendulum, vibrating seconds at the equator and at the level of the sea, was found, when carried to Quito, 9000 feet high, to make somewhat fewer than 60 vibrations in a minute. Since the pole, then, is nearer to the earth's centre than the equator, it should be expected that the pendulum would go slower at the one than at the other; and, accordingly, very numerous and exact experiments on the pendulum, in different parts of the world, have left no doubt of the certainty of this result. The earth.

Cause of its oblateness.—This oblate figure is exactly that which a round mass of stiff clay would assume on being turned rapidly round an axis. The effect will also be more easily exhibited, by fixing the point A, Pl.23, Fig.9. of an iron or steel hoop, A B C D, to the axis A C, the opposite point, C, being also attached to the axis, but allowed to slide freely up and down. On turning the axis, the point C will be observed to descend as the velocity of rotation increases; and the hoop will assume the oblate figure A b c d. This effect is produced by what is termed the *centrifugal* force. It is a tendency which all revolving bodies are found to possess, of flying from the centre of their revolutions, from which they are only preserved at a certain distance by the operation of some very powerful cause;—in ordinary cases, by the cohesion of the materials of which they are composed. This is very well illustrated by a sling;—no sooner do we slip the string by which the stone is confined, but it flies with all the velocity which it has been accumulating from the beginning of the rotation. The analogy between the figure of the hoop and that of the earth, leads naturally to the inquiry, if the resemblance does not extend farther,—if their figures are not also produced by similar causes; and as the earth may certainly contain within itself, like the clay, some principle by which its particles may yield, in a slight degree, to the tremendous impulse of the centrifugal force which the incessant and rapid rotation of such a huge mass of matter would necessarily call into action, its oblate figure is, therefore, in this view, no inconsiderable indication of its motion on an axis, which we have already had some reason to suspect.

SECT. II. *The Effects of the Sun's Light and Heat upon the Earth.*

Length of the days and nights, and variations of the seasons.—The sun, though some philosophers believe it is not the only, is certainly one of the principal causes of the heat which we enjoy; else there would not be so striking a connection between the inequalities of the days and nights, unquestionably the effect of the sun's position, and the vicissitudes of the seasons. It is curious to observe how all these phenomena are made to arise from a single circumstance. We have already seen, in general, how the obliquity of the ecliptic is the cause of the inequality in the days and nights. It is equally the cause of the vicissitudes of the seasons. This obliquity has been found to be nearly $23\frac{1}{2}°$; and as this circumstance of the sun's not continuing always in the plane of the equator (p. 488.) but receding from it alternately towards the north and south poles, is the only one cause which produces these effects, we shall for a moment abstract en-

The earth. tirely from the sun's motion from west to east, and suppose (what by the way seems at first sight really the case) that besides his diurnal motion from east to west, he has also merely a reciprocating motion from north to south, and again from south to north. Thus, let P E p Q, Pl. 23. fig. 1. represent the earth, and *s* S s a portion of the celestial meridian, bounded by the two tropics, situated each at the distance of $23\frac{1}{2}^{\circ}$ from the equator S Q E, and between which the sun S is supposed continually to oscillate from *s*, the tropic of Capricorn in winter, to s the tropic of Cancer in summer, and from s back again to *s*, having crossed and re-crossed the equator S, and finished the year, the period of these variations.

As a candle only enlightens one half of a ball held at some distance from it, in the same manner the sun illuminates but one half of the earth at a time, the opposite one remaining in darkness. Now the boundary between light and darkness,—the line which separates the enlightened from the dark hemisphere, is termed the *circle of illumination*. To the whole of the inhabitants, on one side of this circle it is day, and to the whole of the inhabitants on the other it is night.

This circle, always perpendicular to the direction of the sun's rays, necessarily changes its position along with the sun. When the sun is in the equator, at S, it passes through the two poles P p; and if we ascribe the diurnal motion to the earth's rotation, and not to the sun, (the appearances being the same in either case,) it will retain nearly the same position in the course of a day, and the vicissitude of day and night will be produced by the places on the earth successively plunging below this circle into the hemisphere of darkness, and rising above it into the hemisphere of light. But when the sun arrives at either of the tropics, as in Figs. 2. 3. the circle of illumination also arrives into the position A C, Fig. 2. or A C, Fig. 3. touching the opposite sides of the opposite solar circles, A C, a c. When the sun is at the equator, therefore, the circle of illumination will extend from pole to pole; and as it will be perpendicular to the equator and to all the parallels, it will divide them all into two equal parts. By the effect of the diurnal motion, then, every place will remain just as long in the hemisphere of light, P Q p, as in the hemisphere of darkness, P E p; and the days will thus be equal to the nights all over the world.

The arrival of the sun at either of the tropics considerably alters this state of things. The circles of illumination, Figs. 2. and 3. will then touch the opposite extremities of the arctic circles A C, a c; the enlightened hemisphere will now include the north frigid zone, A P C, Fig. 2. and exclude the south a p c, or include the south and exclude the north, as in Fig. 3. according as the sun in June is north of the equator, at the tropic of Cancer, or south of it, at the tropic of Capricorn, in December. In the middle of June, then, as the revolution of the earth can never bring the inhabitants of the north frigid zone within the hemisphere of darkness, nor the inhabitants of the south frigid zone within the hemisphere of light, the one will have a continued day and the other a continued night. At the equator, however, intermediate between these two extremes, this change in the sun's position will have no effect whatever upon the length of the days and nights, for as the circle of illumination still divides the equator into two equal parts, it will still be equally divided between light and darkness, and the days will still be equal to the nights. Between the equator and the frigid zones, the inhabitants of the different countries will have their days so much longer than their nights, or their nights longer than their days, in proportion as they recede from the equator towards the poles—in proportion as the arcs of their parallels, *a b*, *c d*, are more and more unequally divided between light and darkness, as their distance from the equator increases. In the middle of December, the situation of things is, in every particular, the reverse of this.

It thus appears, that in whatever part of his circuit the sun is, the day is uniformly equal to the night at the equator. As the sun advances towards the north, the circle of illumination recedes from the two poles, lengthening the days in the northern hemisphere, and shortening them in the same proportion in the southern, wholly including the countries round the north pole, which thus begin to have a continued day, and wholly excluding those round the south, which thus begin to have a continued night. When the sun arrives at the tropic of Cancer, which happens about the 22d June, it is then the summer solstice to the countries on the north of the equator beyond the tropics, and the winter solstice to those of the south; the whole of the north frigid zone has days without nights; the whole of the opposite has nights without days; all over the north temperate zone the day is the longest of the year, and all over the south the shortest; and these changes having thus attained their *maximum*, begin to occur in the reverse order, till the sun re-enters the equator on 22d September, the day of the autumnal equinox. Advancing now towards the south, the sun begins exactly to reverse the order which he had produced in advancing towards the north, till he arrives at the tropic of Capricorn on the 22d December; these changes then recommence in the opposite direction, and continue till the equinox of spring, when, as usual, the day is equal to the night all over the world.

Such is the constant progress of the sun, of the days, and of the seasons. Several causes, however, tend to diminish the long obscurity of the polar regions. The least visible portion of the solar disk being sufficient to produce the day, this circumstance adds several days to the time when the sun is visible under the polar circles, because that, after his upper limb reaches the horizon, it is several days before his whole disk is above it. Refraction augments still farther this effect, particularly in the cold countries, where the air is very dense. This was observed in 1597, by three Hollanders, who, having advanced to 84° 0′ north latitude, were stopt by the ice, and obliged to pass the winter at Nova Zembla. After three months of continual night, the cold having become terrible, the sun appeared for a moment at mid-day above the horizon, four days sooner than they had expected it at this latitude, and he continued from this time to rise by degrees.

The twilight also is much longer there than with

The earth. us; twilight comes almost in every part of the earth, when the sun has got 18° below the horizon. Now, to a spectator at the pole, who has in reality the equator for his horizon, the sun would never be 18° below his horizon till he had 18° of declination,—till he had advanced 18° on the other side of the equator, but he never advances beyond $23\frac{1}{2}$°, his greatest declination; the twilight, therefore, will never cease but during the short interval in which the sun moves from 18° of declination to the tropic, that is, to $23\frac{1}{2}$° of declination, and from the tropic back again to 18°; this is about 70 days. So that, on this account, there will only be 70 days of total darkness at the pole, though the sun disappears for six months; and this interval is much less nearer the polar circles.

Besides this, when the moon is north of the equator, she is constantly above the polar horizon.

In fine, a great number of meteors, such as *aurora borealis*, and globes of fire, diffuse their light in those desert regions.

Climates.—The quantity of heat which any place on the earth derives from the sun is greater the longer he continues above the horizon; it also depends upon his elevation. Every one knows, that in the morning, as the sun rises higher and higher in the sky, the day becomes hotter, and as he descends in the afternoon the heat declines in the same manner. The same cause operates at different places throughout the year, by the sun's rising to different elevations; and the effect is greatest at the equator, decreases towards the north and south, and is least of all at the poles. As the sun's declination at the equator never exceeds $23\frac{1}{2}$°, his meridian altitude is never less than $66\frac{1}{2}$°, and his rays are therefore never very far from falling quite perpendicularly upon the surface of the ground, while at the poles his altitude never exceeds $23\frac{1}{2}$°, and his rays are thus never very far from falling quite parallel upon the surface. By the combined effect of these two causes it is found, that, if the whole heat received at the equator be 100, the whole heat received at the pole is only 40; between these extremes it varies by regular gradations, and in the parallel of 45° amounts to 73; and this is one powerful cause of those remarkable varieties in the climate of different countries, from the equator towards the poles. It is on this account that the heat is so excessive in the torrid zone, and the cold in the frigid zones, that while the beauties of nature are scattered with the utmost profusion in the one, the others are barren and almost uninhabitable, and that the countries, such as Europe, in the temperate zone preserve a happy medium between these extremes.

Sect. III. *On the Tides.*

When we consider how invariably every motion which we are able to produce on the earth terminates finally in rest, we are apt to imagine that rest is the natural state of bodies, and to enumerate among their properties that of sluggishness, inactivity, or *vis inertiæ*, as it is termed. The celestial bodies seem to present an order of things the very reverse. As they are continually changing their position, activity seems to belong to them in a much greater degree than sluggishness to the bodies on the earth, and the matter of which they are composed is thus apparently of a different nature. What are we to think then, of the perpetual movements of the ocean, which changes its figure every instant of the day, by regular and periodical oscillations, known by the name of the *tides*. "It is a circumstance truly astonishing," says La Place, "to behold, even in calm and serene weather, the intense agitation of this great fluid mass, whose waves constantly break with impetuosity upon the shore. This phenomenon gives rise to reflection, and excites a strong desire to penetrate the cause." The following are its appearances. Of motions.

Twice every day the waters rise in our harbours, inundate our shores, and ascend our rivers to great distances, and with great rapidity. This *flux* of the tide continues with accelerated velocity for three hours; it then gradually diminishes, and in three hours more ceases altogether; this is *high-water*, or *high-tide*. The waters having now attained their greatest elevation, the tide *turns*, *the reflux* begins, and the whole mass of the ocean moves for six hours more in the contrary direction; it is then *low water*. The waters have now attained their greatest depression; and, after a short interval of repose, the intermediate step in every motion which reverses its direction, the tide again turns, runs for six hours in the same direction as at first, and again for six hours in the opposite.

The slightest observation is sufficient to shew, that these variations are connected with the moon, as they follow her motions with wonderful regularity. The moon, as we have seen, rises later and later every day, until the end of the month, when she again rises nearly about the same hour as at first. The time of high-water happens also, until the end of the month, later and later every day, and in this manner performs the complete circuit, (if we may be allowed the expression,) of the 24 hours, in the same time that the moon performs the complete circuit of the heavens.

The sun has also a sensible connection with the tides; for when the moon is in conjunction, the oscillation of the ocean is then the greatest, the tides being then invariably highest at high-water and lowest at low-water; it is then *spring-tide*. When the moon is in opposition, the tides are then lowest at high-water and highest at low-water, and it is then *neep-tide*. This connection has been traced in all its details, and for almost every inequality in the motions or in the distances of the sun and moon, a similar inequality has been found in the motions of the ocean and in their intensity; there can hardly be a case, therefore, where we could say with more propriety, that the one is the *cause* of the other.

It thus appears, that the earth is intimately connected with the bodies in the heavens, and probably, therefore, forms a part of the same system. But the heavenly bodies are continually in motion,—Can we believe, then, that the earth is in complete repose?

Chap. III. Of the Motions common to all the Heavenly Bodies.

We have already discovered one motion, namely the diurnal, to which all the heavenly bodies, without any exception, are subject. There is another of the

Of motion. same kind, which, on account of its slowness, is not so easily observed, but whose accumulated effect is rendered quite sensible by comparing ancient with modern observations.

Since the time of the ancient astronomers, its effect is visible to the naked eye; for the pole star, which is now within 2° of the pole, was far distant from it in the time of Hipparchus, who was the first to notice this curious motion, and who was thence led to set down in a catalogue the positions of the stars, that posterity might be thus enabled to recognise any change in their positions. The event proved the utility of this bold project, as it is from his observations that the mean quantity of this motion is still deduced. Thus, Hipparchus, 128 years before Christ, found the longitude of the star *spica virginis*, 5*s*. 24° 0′; and in 1750 it was 6*s*. 20° 21; so that in 1878 years its longitude had increased no less than 26° 21′, more than $\frac{1}{15}$th of the whole circumference. Now the longitude of a star is its distance, reckoned upon the ecliptic, from the vernal equinox. Either then the above star must have advanced slowly from the vernal equinox towards the east, or the equinoxial point itself, in consequence of some change in the positions of the equator, or ecliptic, of which circles it is the point of intersection, must, on this account, have retrograded from the star towards the west. But this motion is found in all the stars, without any exception; it is natural, therefore, to ascribe it rather to a regression in the equinox itself; and accordingly it has been termed the *precession of the equinoxial points*, or *of the equinoxes*.

The next object was to discover whether this precession belonged to the ecliptic or the equator; and it has been found, by comparing together a variety of observations, that while the latitudes of the stars, or their distances from the ecliptic, remain always nearly the same, their increase of longitude is accompanied by an increase of right ascension in all of them, and of their declinations or distances from the equator, by a small increase in some, and decrease in others. In short, all the appearances are represented by supposing either the celestial sphere, or the earth itself, to have a compound motion, of which the diurnal is only one of the elements. In the first case, the earth, c, (Plate 23. Fig. 4.) along with the axis of the equator, P p, would remain at rest, and the sphere, P E p Q, would not only revolve once a day on the axis, P p, of the equator, E Q, and in the direction E c Q, from east to west, but, at the same time, would have also a much slower motion upon the axis, *P p*, of the ecliptic *E* C, and in the opposite direction, *E* c C, and not completing a revolution in less than 25,000 years.

By the effect of this motion, different stars will occupy the position of the north pole in different ages; in 13,000 years the pole star, which is now only two, will be more than 40° from it; and the sphere will thus seem in different ages to perform its diurnal rotation on very different points.

But this motion is equally represented by ascribing it to the earth, whose axis, P′ p′, Fig. 4. always corresponding to the same point of its surface, and quite exempt from any diurnal motion, would nevertheless, have upon its centre, c, a slow conical motion round an axis, *P′ p′*, passing, when produced, through the poles of the ecliptic, *P p*. By the effect of this motion, the poles, P′ p′, would correspond successively to different parts of the heavens, and thus the same appearances would be produced, but unquestionably in a much simpler manner.

The sun.

Chap. IV. Of the Sun.

Sect. I. *Distance and Magnitude of the Sun.*

Distance.—When we attempt to find the sun's distance from the earth, by observing his position at the same instant from different places, it is found to be so great, and his horizontal parallax so small, as not to be determined in this manner with any degree of exactness. All that can be discovered from it is, that this distance is at least 6000 diameters of the earth. The observation of what are termed the *transits of Venus* over the sun's disk, affords the means of determining his parallax with much greater precision; and in this manner it has been fixed at 8″ 7, and his distance at 95 millions of miles.

Magnitude.—At this distance we are certain that the earth would appear under an angle of no more than 17″, and the mean apparent diameter of the sun is 32′ 3″. Hence, as the volumes of spherical bodies are as the cubes of their diameters, the volume of the sun is at least 200,000 times greater than that of the earth.

Sect. II. *Motions of the Sun.*

We have already found, by abstracting entirely from the sun's diurnal motion, that he appears to revolve round the earth once a year, in a plane which is inclined to the equator at a certain obliquity. But one body may move in a plane round another in a variety of ways. The sun may continue always in the same plane, while he may move in a circle, in an ellipse or oval, or in any other re-entering curve, of which the earth also may occupy either the centre or any other point. The sun may also move in his path in a regular or an irregular manner. All these things can only be determined by measuring with greater exactness his positions at different times of the year, and comparing them with each other.

For this purpose his meridian altitude, and the interval of time between his passage and that of a star over the meridian, are observed with extreme precision every day. From the one is deduced his declination, from the other his right ascension. These data give us a complete series of his longitudes, or of his angular positions on the ecliptic; and one element more, namely, his distance from the earth, is only necessary to complete our knowledge of his positions in space. To the above observations, therefore, are joined those of his apparent diameter, and we are thus enabled to delineate the series of points which the above angular and linear distances determine, and to exhibit, by their union, a reduced plan of the solar orbit. In this manner may the sun's path be recognised, by observations continued for a single year. But it was only by successive approximations that the discovery was first made, and this process may perhaps better illustrate the nature of the motion.

The sun.

If the sun move uniformly round the earth as a centre, his distance from it, and his velocity, should be always the same; but very sensible variations are observed in his apparent diameter, the index of his distance, as well as in his daily motion in longitude, the measure of his velocity,—the difference between his position to-day and his position to-morrow. On the 1st of July, for example, his diameter was found to be 31′ 31″, and on the 1st of January 32′ 35″ .6, while he moved from the 1st to the 2d of July 57′ 13″ in longitude, and from the 1st to the 2d of January 1° 1′ 11″. Neither his distance, therefore, nor his velocity, is constant, and he cannot move uniformly in a circle of which the earth occupies the centre.

But by ascribing to the earth an eccentric position, the sun might still retain his uniform circular motion, and at the same time exhibit variations both in distance and velocity. For at the point S, Pl. 23. Fig. 5. in the circle S A s, he would be nearer to the earth E, than at the point S, by twice, E C, the earth's distance from the centre C; while, on account of this proximity, his velocity at S, though really the same, would appear greater than at s; the space S 1 which he describes in a day at s, though really equal to s 1, which he describes in a day at s, would appear to a spectator on the earth to be magnified in the exact proportion of the distance E s to E S, in the proportion of his apparent diameter at S, to his apparent diameter at s. Let us see, then, if this proportion actually holds. His apparent diameter on the 1st of July and on the 1st of January, were to each other as 31′ 31″ to 32′ 35″ .6; that is, as 1 to 1.0339, while his corresponding velocities were to each other as 57′ 13″ to 1° 1′ 11″, that is, as 1 to 1.0693, instead of being as 1 to 1.0339. The same proportion is observed in every other part of his orbit. The sun, therefore, cannot move in a circle at all; and the last supposition, though it more nearly represents the appearance, is still far from the truth.

By proceeding in this manner, from one hypothesis to another, it was at last discovered by the celebrated Kepler, that a single and very remarkable law connects together these distances and velocities. He found, that while the sun's distance from the earth increases, his velocity diminishes in a ratio only half as great, that is to say, if his distance at any point of his course be 1, and his velocity 1, then, if his distance at any other point were 2, his velocity would be $\frac{1}{4}$, and if his distance were 3, his velocity would be $\frac{1}{9}$. From this it follows, that if a line E S, Fig. 5. termed the *radius vector*, be conceived to join their centres, and to be carried round the earth by the revolution of the sun, *the areas described by the radius vector, are always proportioned to the times of description*. Thus, if S 1 2 3, be the position of the sun in successive days, then the areas S E 1, 1 E 2, 2 E 3, &c. are all equal, being described in the same time; and the areas S E 1, S E 2, S E 3, &c. are proportional to S 1, S 2, S 3, &c. the times in which they are described. This law is termed *the first law of Kepler*.

Now the curve called the ellipse is the only one which satisfies the conditions of this law,—is the only one in which one body can move unequally round another, and describe by its radius vector, areas proportional to the times. Hence is deduced the *second law* of Kepler, *that the solar orbit is an ellipse of which the earth occupies one of the foci*.

The sun.

The ellipse is that curve which is described by fixing upon two immoveable points, F *f*, Fig. 6. the extremities of a thread, F A′ *f*, a pencil A stretching the thread to the position F A *f*, and sliding along it, then traces the ellipse A B E D. The immoveable points F *f*, are termed the *foci* of the ellipse. The line B F *f* D which joins them, and being produced both ways, terminates at the curve in the parts B D, is called the greater axis of the ellipse. It is the direction in which the curve is elongated, and is evidently equal to the length of the thread. The line A C E, drawn through the centre C, perpendicular to the greater axis, and meeting the curve in the points A E, is the lesser axis. It is round the earth, situated in one of the foci E, Fig. 7. that the sun seems annually to revolve in the course P B A. The point P, in which he is nearest the earth,—where his apparent diameter also, and his velocity, are the greatest, is termed the *perigee*. The opposite point A, where he is farthest from the earth, and where consequently his diameter and velocity are the least, is termed the *apogee*. At the intermediate point, B, his distance is a mean between his greatest and least distances; it is then equal to A C, the half of the greater axis A P. The distance C E, from the centre to the focus, is termed the *eccentricity*. It is evidently equal to the difference between A E, and A C, equal to the excess of his greatest above his mean distance. The smaller the eccentricity of an ellipse, or the smaller the distance between its foci, the nearer does it approach to a circle, which is its form when the eccentricity becomes nothing,—when the two foci are united in the centre of the ellipse.

The solar ellipse, in form, differs but little from a circle. The eccentricity amounts to little more than one-sixteenth of the mean distance; but neither its form nor its position remains always the same. They are subject to slow changes, which are only rendered sensible by the comparison of distant observations, and are termed *secular inequalities*. Since the period of the most ancient observations, the eccentricity has been diminishing; and at a rate which, if it were to continue uniform, would change the sun's orbit into a circle, and his unequal into a uniform motion, in about 36,000 years. The position of the orbit is fixed by the inclination of its plane to that of the ecliptic, and by the inclination of the greater axis to the line of the equinoxes; that is, by the longitude of the apogee or perigee. Now the orbit is found to approach by insensible degrees to the equator, and the longitude of the apogee to be continually increasing; so that if A P, Fig. 8. be its position in one age, A′ P′ will be its position in another; the secular diminution, or the diminution in a century, of the obliquity of the ecliptic, is 12″, and the secular progression of the axis relatively to the fixed stars is 19′ 4″.

The elliptic motion, however, even with all these variations, does not exactly represent modern observation. Their extreme precision has indicated small inequalities, of which the laws have only been developed by the discovery of their cause.

The sun.

Sect. III. *Measures of Time.*

The events indicated by the motions of the sun have been universally adopted for the standard measures of time. The intervals that elapse between his successive arrivals at the same equinox, form the years; and the intervals between his successive arrivals upon the meridian, form the days.

Days.—In civil life, the day is the interval between the rising and setting of the sun, and the night the period of his continuance below the horizon. What is termed the *solar, or astronomical day*, is the interval between two consecutive noons, or midnights,—between the instant of the sun's transit to-day, and the instant of his transit to-morrow. When time-pieces were introduced, and came gradually to be improved, a variation was perceived in the length of the solar days. The clock was found not to keep exact pace with the sun; and the nicer its construction, the more clearly did it indicate this inequality.

Mean time.—Since the solar day, then, is not always of the same duration, it is necessary to adopt another which shall have this property, and with which our clocks may correspond. For this purpose astronomers have adopted that which is termed the *mean* solar day, its length being a medium between all the solar days in the year. The time measured by these mean days, is called *mean time*; that measured by the true solar days, *true, or apparent time.* Apparent time is that which is indicated by a sun-dial; but it is according to mean time that all our clocks are regulated, and all our reckonings made. As the beginning and end, however, of the mean, is not indicated by any phenomenon, as that of the true day is by the solar transits, the clock can still only be regulated to mean time by observing the instant of the sun's transit, and applying to it the difference between the true and the mean time, which is found by calculation.

Equation of time.—This difference is called *the equation of time.* It is the number of minutes and seconds by which the noon of a well regulated clock ought to precede or follow that of a dial. It is set down on a table for every day of the year; and to regulate a clock, it is only necessary to set it, so that when the sun crosses the meridian, the hand of the clock may be distant from the hour of XII, either before or after it, by a quantity equal to the equation of time for that day, as shown in the table.

Two causes contribute to produce this inequality in the solar days; the unequal motion of the sun in his orbit, and the inclination of that orbit to the equator.

Years.—The revolutions of the sun, from any point to the same point again, are in general termed years, of which there are several kinds, namely; 1. The solar or *tropical year,* which is the interval between the successive arrivals of the sun at the same tropic; 2. The *sidereal year,* the interval between his arrivals at the same star, which consists of $365^d\ 6^h\ 9'\ 11''$; and, 3. The *anomalistic year,* the intervals between his arrivals at the apogee or perigee, which consists of $365^d\ 6^h\ 14'$.

Kalendar.—It is the tropical year which regulates the return of the seasons; and as it does not contain a complete number of solar days, the mode of adjusting the kalendar is somewhat complex. For this purpose, the exact length of the year,—the number of days, hours, &c. that elapse between two consecutive arrivals of the sun at the equinox must be known. But the year is not always of the same duration any more than the day. It is subject to an inequality, of which, as it depends upon the precession of the equinoxes, the period is 25,950 years; and the length of the mean solar year, by which the kalendar is regulated, is the medium between that of all the years of this period. By comparing ancient with modern observations, its length has been found 365 days, 5 hours, 48 minutes, 50 seconds.

If the length of the year were reckoned exactly 365 days, it would produce no inconvenience for two or three years; but in four years the error would amount nearly to a day, and we would then begin the new year a day before the other was ended. The error, however, would continually accumulate; and after a certain period, the beginning of the year would correspond successively to every day of spring, summer, autumn, and winter. To avoid this inconvenience, we make every fourth, or leap year as it is termed, consist of 366 days; and this addition of a day is termed *intercalation.* But the error does not amount exactly to a day in four years; hence another correction is necessary at the end of a century, when the leap year consists of only 365 days; and to obtain still greater accuracy, a third correction is applied at the end of four centuries, when the secular leap year is made, like the rest, 366 days. In this manner the days of the year are made to correspond with the days of the seasons for any length of time, and with the greatest exactness.

Sect. IV. *Nature of the Sun.*

Spots.—At such an amazing distance, it seems vain to hope that we shall ever discover the nature and constitution of the sun. The indefatigable labours of modern astronomers have nevertheless led to some curious results regarding it. The face of the sun, when viewed with a telescope, though of a bright and intense light, far above that of any other object, is often marked with dark *spots,* which, when examined from day to day, are found to traverse the whole surface, from east to west, in the space nearly of 14 days. The number, magnitude, and position of these spots are extremely variable. Sometimes they are so large as to be seen through a dark glass with the naked eye. In the year 1779, Dr Herschel perceived one about 50,000 miles in diameter,—more than six times the size of our earth. When a spot is first discovered on the eastern limb, it appears like a fine line; its breadth augments as it approaches the middle of the disk, from which it diminishes as it goes over to the western limb, where, at last, it entirely disappears. The same spot, after 14 days, is sometimes discovered again on the eastern side. It is not often, however, that this happens, as the spots during that period disappear, leaving sometimes behind them a superior brightness or luminous spot, termed a *facula,* in the position which they had occupied. Many of the spots disappear altogether in the course of a few days. Sometimes a number of

The sun.

small spots unites into one large spot; at other times a large spot separates into a number of small ones, which soon entirely disappear. The central portion or dark nucleus of a spot, is usually surrounded with a *penumbra* or fainter shade, and both the nucleus and the penumbra are almost perpetually changing their appearance. When Dr Long was examining the sun's image, received upon a sheet of white paper, he observed a large round spot divide itself into two, which receded from each other with immense rapidity. The Rev. Dr Wollaston also observed a spot to burst in pieces, like a mass of ice thrown upon a frozen pond.

As might have been expected, the opinions of astronomers are divided concerning these singular appearances. According to some, the spots indicate an abatement, previously to a general extinction of the great conflagration which had hitherto raged with unabated fury upon the sun. Some suppose them to be elevations or islands, which appear and disappear by the flux and reflux of an ocean of liquid fire; while others consider them merely as the scum which floats upon the surface of this immense fluid mass. La Place conceives them to indicate vivid effervescences, of which our volcanoes form but a feeble representation. But Dr Wilson, of Glasgow, was induced, by his own observations, to reject entirely the notion of the sun's being an igneous body. The observations of Dr Herschel, with the most powerful telescopes that have ever been contrived, lead him to support a similar theory, and even to hazard the opinion of the sun's being a habitable world. The sun, he supposes, consists of a dark, solid nucleus, surrounded by two strata of clouds, from the exterior of which proceed that heat and light which extend to the remotest extremities of the system, while the interior stratum serves to screen the inhabitants of the centre from the fury of the element which rages around them.

This theory is certainly liable to many objections, and others have been accordingly proposed with the view of obviating them; but the want of facts is a bar to any just theory upon the subject. That great changes are continually going on at the surface of this enormous mass can hardly be doubted; but the nature of these stupendous operations, on account of the distance at which they take place, must probably continue for ever unknown. A connexion has been supposed to exist between the appearance of the spots and the heat which the sun emits; but the grounds of this opinion are not considered by all as fully satisfactory.

Rotation.—Whatever be the nature of the spots, they have made us acquainted with a remarkable phenomenon, *the rotation of the sun upon an axis.*

By observing their successive positions, it is found, that the paths of different spots are always parallel and similar to each other, but that they are all subject to change of figure, which, as they go through all their variations, and are regularly repeated every year, are evidently connected with the positions of the sun. They are all completely represented, by supposing the spots to be attached to the spherical surface of the sun, and to revolve along with him in a certain period, and on an axis inclined at a certain angle to the ecliptic; and as no fact has been discovered at variance with this hypothesis, it can hardly be doubted that this is really the case. The axis of his rotation has been calculated, from these observations, to be inclined to the plane of the ecliptic at an angle of 7° 20′, and the period of his rotation to be $25^d\ 5^h\ 56^m$. It is less than the interval between the successive appearances of a spot; but this arises from the rotatory motion of the spot being, to a spectator on the earth, combined with the sun's annual motion from west to east, which, being in the same direction with that of the spot, has the effect of protracting the instant of its reappearance.

The moon.

Chap. V. Of the Moon.

Sect. I. *Distance and Magnitude of the Moon.*

Distance.—The same method which was insufficient to determine with requisite exactness the parallax of the sun, discovers that of the moon, at a medium 57′ 39″, which gives the moon's mean distance at 240,000 miles.

Magnitude.—At this distance, then, the earth subtends an angle of 1° 51′ 18″; while the moon, at the same distance, subtends an angle only of 31′ 20″. Their diameters, therefore, are in the ratio of these numbers, or very nearly as 3 to 11; and the volume of the lunar globe is 49 times less than that of the earth.

Sect. II. *Motions of the Moon.*

By pursuing the same method which enabled them to recognise the motions of the sun, astronomers have discovered those of the moon. By observing her meridian altitude, declination, and apparent diameter, every day, the positions of a series of points are obtained, and their union forms a representation of her orbit. From these observations it has been found, that her motions exactly resemble those of the sun, but on a smaller scale. Like the sun, she approaches and recedes from the earth—goes quicker in one part of her course than in another. The line drawn from her centre to the centre of the earth, describes round it areas proportional to the times; and, in short, she moves in an ellipse of which the earth occupies one of the foci. The plane of the moon's orbit is inclined to the plane of the ecliptic 5° 8′ 49″; it cuts it, therefore, in two opposite points, as in Pl. 21. Fig. 17. These points are termed the *nodes*; and the imaginary line which joins them, the *line of the nodes.* The ascending node is that where the moon crosses the ecliptic in ascending towards the north pole; the descending node is the opposite one, where she crosses the ecliptic to descend towards the south. The position of the nodes is indicated by the moon having no latitude, or being in the ecliptic. Her mean distance, or half the greater axis of her ellipse, being one, the eccentricity is 0.055; but neither the form nor the position of her orbit remains the same. Like the orbit of the sun, it is subject to a very complicated motion, which is represented by decomposing it into several elements. 1st, It has an oscillatory motion upon its lesser axis, by which its inclination to the ecliptic is continually varying. 2d, It

The moon.

has a rapid motion of rotation round its focus, the earth, by which the apogee is made to describe, from west to east, a sidereal revolution in $8^y\ 312^d\ 11^h\ 11^m\ 30^s$, and which is easily recognised by observing the stars with which the moon is successively in contact, when she successively arrives at her apogee, or has successively her least diameter. And, lastly, It has another motion, by which the nodes perform a revolution among the stars, and along the ecliptic, in a period of $18^y\ 223^d\ 7^h\ 13^m\ 17^s$. The comparison of ancient with modern observations shews also incontestibly an acceleration in its mean motion, which, though little sensible since the most ancient recorded eclipse, will be developed in progress of time; but the discovery of its cause has anticipated these observations, and shewn, that after a certain period it will stop, and be converted into a retardation, and thus go on for ever.

The elliptic motion, however, is much farther from representing the true motion of the moon than of the sun. This motion is subject to a great many other irregularities; so that the ellipse, even with all the above changes in its figure and situation, is still only the mean orbit of the moon, to which the application of not one but many equations is still necessary to form the true motion. The knowledge of these equations is necessary for the construction of correct lunar tables, an object of so much importance since the idea was conceived of employing her motions for determining the longitude at sea.

The revolutions of the moon to different points, in general termed months, are of different lengths, on account of the motions of the lunar orbit. The *synodical* month is the interval between two consecutive arrivals of the moon in conjunction with, or in opposition to the sun; its mean length, as determined by a comparison with ancient and modern eclipses, is $29^d\ 12^h\ 44^m\ 2^s$. The *sidereal* of $27^d\ 7^h\ 43^m\ 11^s$, is the interval between the moon's successive arrivals at the same longitude with a star; the tropical, $27^d\ 7^h\ 43^m\ 4^s$; and the anomalistic, $27^d\ 13^h\ 18^s\ 37^m$, the interval between its successive arrivals at the apogee or perigee.

Sect. III. *Eclipses.*

We have already explained the reasons for ascribing the eclipses of the moon to the circumstance of her passing through the shadow of the earth, and the eclipses of the sun to her casting a shadow upon the earth, and thus depriving us for a time of his light. A more correct knowledge of the lunar motions has left no doubt of this result, by shewing that at the time of an eclipse the position of the moon coincides exactly with that of the body M, Plate 21. Fig. 16. which, casting behind it a shadow, *a b c d*, darkens the sun; and that the position of the earth's shadow coincides exactly with *e f g h*, which darkens the moon; so that the beginning and end of these phenomena can be predicted to less than a minute for a great many years in advance. For this purpose it is only necessary to find, from the lunar and solar tables, when the moon and the earth have such positions relatively to the sun as ultimately to deprive each other of his light.

It is obvious that no eclipse can happen but when the centres of the sun, the moon, and the earth are almost, if not altogether, in one straight line. Thus, if the moon, in her monthly revolution, never approached nearer than at M′, Fig. 16. to the line S E, which joins the earth and sun S, its shadow, whatever might be its range, would go quite beyond the earth, and in like manner the shadow of the earth would go quite beyond the moon at m; but as the centre of the moon, when she is either beyond the earth, or between the sun and the earth, approaches the straight line, S E, its shadow, if long enough, will fall more and more upon the earth on the one hand; and she would herself enter farther and farther into the shadow of the earth on the other. To produce an eclipse, then, it is necessary that the sun and moon be either at least very nearly in the same, or very nearly in the opposite direction relatively to the earth.

By calculating the positions and magnitudes of the sun and moon it is found, upon the whole, that when the moon in opposition is about $12\frac{1}{2}^\circ$ from the node, there can be no lunar eclipse, and when less than 9° distant from it there must be one; and also that if the moon in conjunction is within $17^\circ\ 21'$ of the node, there may be a solar eclipse,—if it be more distant, there can be none.

If the distances, then, of the new and full moons from the nodes are without the *ecliptic limits*, there will be no eclipse; and if within them, an eclipse will certainly happen, of which the time, duration, &c. may be calculated according to the directions which usually accompany the tables.

A very near approximation, however, to the time of an eclipse is discovered with facility, by means of the famous period of 18 years $10^d\ 7^h\ 43^m$, at the end of which period the sun and moon, recommencing very nearly the same series of positions that they had before, all the eclipses of the sun and moon recur nearly at the same time.

Sect. IV. *Nature of the Moon.*

The phenomena of eclipses prove incontestibly that the moon is, like the earth, an opaque mass of matter, deriving most, if not the whole, of her light from the sun; and the phenomena of her phases, of which the explanation already given is thus fully confirmed, are equally decisive as to her roundness. The discoveries of the telescope have still farther extended this analogy, by shewing that the irregular mottled appearance which she presents, even to the naked eye, arises from the extreme diversity of her surface, on which a careful examination discovers what is believed to be great mountains, level plains, and deep vallies. That this is really the case, is concluded from the appearance of dark spots behind the mountains, which, as they vary with the position of the sun, can only be the shadows which they cast behind them on the plains. Before the full moon we see these mountains, forming a very ragged border between its enlightened and dark hemisphere, and projecting their summits beyond the line of light by a quantity which, being measured, indicates their height; according to some astronomers, it surpasses that of any of the mountains on the earth, amounting in many cases to 4 and even 5 miles, while others conceive these estimates to be somewhat exaggerated. The lunar cavities are also indicated by the darkness of the one side, and the brightness of the other, which is opposite the sun; while this contrast vanishes as the moon approaches the opposition where the sun's rays fall directly upon its surface. The depth of these cavities has been estimated at from 2 to 3 miles; they resemble nothing on the earth except it be the bason of our seas. These mountains, cavities, and other irregularities are quite permanent, and preserve always nearly the same position on the moon's surface; its promontories and other remarkable points have been named by some after the most celebrated astronomers—and, by others, after the mountains and countries on the earth.

Atmosphere.—It was long doubted, whether the moon, like the earth, was surrounded by an atmosphere. The fact seems now, however, to be established by the observations of Schroeter. This celebrated astronomer discovered in the moon a faint glimmering light, extending a little beyond the crescent into the dark hemisphere. From the breadth of this line of light, which he ascribes to the twilight produced by the lunar atmosphere, he infers that the height of the denser portions of that atmosphere which reflects the rays of light, and which on the earth rises forty-five miles, cannot be more than 1500 feet; and where it would cease to affect the brightness of a star, not more than 5700 feet. In the observations accordingly, which he made on the stars, scarcely any indistinctness could be observed in them before their disappearing behind the moon. Such being the extreme rarity of its atmosphere, we may conclude that no terrestrial animal could live or respire at the moon, and that its inhabitants, if there be any upon it, must be of a different nature. It is well known, that fluids are more easily dissipated into vapour in proportion as the weight which compresses them is withdrawn. There is reason to think, then, that where so little atmospheric pressure prevails, all must be solid at the surface of the moon. And though its level plains were at one time ascribed to the smooth surface of its seas and lakes, more exact observations render extremely doubtful the existence of any great body of water. The most powerful telescopes rather present the moon to us as an arid mass upon which some have thought they perceived the effects, and even the explosion of volcanoes.

Moon's rotation.—From the motion of the solar spots has been inferred the rotation of the sun on his axis. The same conclusion is drawn, in regard to the moon, from the apparent rest of her spots. For as we go round and round a building when we wish to have a view of it on every side, in the same manner would the moon present to us, in succession, every portion of its surface, if, without moving on its axis, it only revolved round the earth, the appearances being evidently the same as if the earth went round and round the moon at rest. Thus, if a spectator on the earth should observe a remarkable spot S, Pl. 23, Fig. 11. on the centre of the full moon at M, he would evidently lose sight of it by the time the moon, if immoveable on her axis, arrived at her quarter at *m*; and another spot *s*, which he did not at first observe, would now occupy the same centre position; and in order that the same spot as at first should still be observed on her centre, it would be absolutely necessary for her to make a quarter rotation in a direction contrary to that of her revolution. When the moon, therefore, in revolving round the earth, still presents to us a figure whose general appearance, though extremely irregular is always the same, and which must on this account be undoubtedly the same half of her surface, we may be assured that the moon has really a rotation on its axis, in a direction contrary to and keeping exact pace with her revolution round the earth.

Continued observations, however, have discovered some slight motions in the lunar spots; they seem to approach to and recede alternately from the limb; those that are very near the circumference appear and disappear successively on the opposite sides; those on the east appearing while those on the west are disappearing, and conversely; so that the moon herself seems subject to a periodical oscillation on its axis, termed the *libration of the moon*, of which there are three kinds, and all of them apparent and relative to a spectator on the earth. The first is termed the *diurnal libration*,—the second the libration in longitude,—the third the libration in latitude.

Chap. VI. Of the Planets.

The motion of the planets, as we have seen, appears to be extremely irregular, and we have also explained the hypothesis upon which all these irregularities are made to vanish. The indefatigable labours of modern astronomers, aided by the exquisite refinements of science and of art, have confirmed, in a most surprising manner, the truth of this hypothesis, and established upon the evidence of the senses the existence of the beautiful system which Pythagoras had only suspected, on account of its extreme simplicity.

They have also discovered five other bodies, which, as their motions are of the same kind, have been added to the list of the planets. The following are their names :—Juno, Vesta, Ceres, Pallas, and the Georgium Sidus, Herschel, or Uranus. The four first move in orbits, which lie between those of Mars and Jupiter; the last is at the greatest distance of all from the sun; its orbit lies beyond that of Saturn.

By applying the micrometer to measure the apparent diameters of the planets, it is found that their distances from the earth are subject to variations much greater than those either of the sun or moon; and by comparing these distances with their observed right ascensions and declinations we obtain a series of their positions, whose union forms the figures of their orbits. But, on setting down these positions relatively to the earth every day, and joining them together, there arises, for each of the planets a curve, so extremely complex, that the ancient astronomers, neglecting the system of Pythagoras, only wasted their ingenuity in their attempts to reduce them to greater simplicity. Each planet was supposed to move uniformly in a circular orbit, itself in motion on the circumference of another circle, and this again moving round the earth. Each new inequality, however, which observation gradually brought to light in the motions, required the assumption of a new circle or *epicycle*, as it is termed, to represent it; and thus the system, instead of growing in strength and simplicity with the progress of discovery was visibly approaching in complexity that which it attempted to explain. At last the idea was again revived of setting down, not the position of the planets relatively to the earth,—not their *geocentric*, but their *heliocentric* positions;—the positions found by calculation in which they would have appeared to a spectator on the sun.

True orbits of the planets.—The developement of this happy idea has changed the whole aspect of the heavenly motions, and order and consistency have succeeded to the former confusion. It was now found, and the observations of nearly 500 years have only more and more confirmed this result, that a single law, the same which we have already explained for the sun and moon, pervades the whole planetary motions. When their distances from the sun, and their directions are set down for every day, it appears, that while the distances increase, their velocities diminish; so that the radii vectores continually describe areas proportional to the times. In a word, that they all move in ellipses, of which, however various the forms and positions, the sun is the common focus. These ellipses, except in a few cases, differ but little in form from circles; they are all subject to the same kind of changes, both in form and position, and the planets to the same kind of deviations from them with those which have been described in the cases of the sun and moon; the planes of their orbits are all somewhat inclined to that of the ecliptic, though this obliquity never exceeds 7°, except in the case of the new planets between Mars and Jupiter; the point which is termed the apogee in the solar orbit, is termed the *aphelion* in those of the planets; the perigee, the *perihelion*; these points are also termed the *apsides*; and the line which joins them, namely, the greater axis of the ellipse, the *line of the apsides.*

Plate 25. Fig. I. represents the relative dimensions of the orbits of the planets, with the positions of their aphelia and perihelia, their mean distances from the sun in millions of miles being also set down for each. Fig. 2. represents the inclinations of their orbits. Pl. 24. Fig. 5, 6, 7, 8, represents their relative magnitudes, their diameters in English miles being also set down along with the name of each; and the following are the periods of their revolutions; the eccentricities of their orbits, their mean distances being 1; and their mean apparent diameters as seen from the earth:

	Sidereal Revolutions.			Ecc. orbits.	Ap. diam.
	years.	*days.*	*hours.*		
Mercury....	0	87	23	0.205	10″
Venus.......	0	224	16	0.006	58″
Mars........	1	321	23	0.093	27″
Vesta.......	3	240		0.093	0″.5
Juno........	4	131		0.255	3″
Ceres	4	221	12	0.078	4″
Pallas.......	4	221	15	0.245	3″
Jupiter.....	11	317	14	0.048	39″
Saturn......	29	174	1	0.056	18″
Uranus.....	84	29		0.046	4

A very remarkable law, and it is the *third* of the laws of Kepler, connects together these periods with the mean distances of the planets from the sun. It is found, on comparing them together, that *the squares of the periods of the revolutions of the planets are proportional to the cubes of their mean distances.* Thus the period of Jupiter is 4332^d, 14^h, and of Mercury 87^d, 23^h, and the squares of these numbers are nearly as 2425 to 1. Now the mean distances of these planets are expressed by 5.2027 and 0.3871, that of the earth being 1, and the cubes of these numbers are to each other nearly as 2427 to 1.

The new planets between Mars and Jupiter are distinguished from all the rest by their smallness, by the great inclination of some of their orbits to the ecliptic, by their great eccentricity, and, above all, by their orbits crossing each other. These, and other circumstances, which a minute examination of their magnitudes, orbits, &c., has brought to light, lead some to suppose that they are the fragments of a larger planet which once existed between Mars and Jupiter, but which has been burst in pieces by some internal convulsion.

Sect. II. *Nature of the Planets.*

Such are the principal elements of the orbits of the planets. Not content, however, with thus ascertaining, in the completest manner, the laws of their positions; not content with considering the planets merely as luminous objects, astronomers have endeavoured, by means of the telescope, to extend their views into the interior of these apparently impenetrable regions; and the more these researches are continued, the more do these bodies seem to form the parts of a great system,—the more do they resemble each other; and, what is very remarkable, the more do they resemble the earth.

Inferior planets.—Mercury, the nearest of the planets to the sun, is, on that account, in a situation the most unfavourable for observation. Venus, the other inferior planet, is much larger, much nearer to the earth, and much longer visible. On the invention of the telescope, accordingly, very interesting discoveries were made upon her surface. To the naked eye she presents always a full orb, but through the telescope exhibits the same phases with the moon. When first seen in the morning before sunrise, she appears in the form of a slender crescent, with its horns towards the east; her apparent diameter is then also nearly the greatest. In proportion as she advances towards the west, and approaches her greatest elongation, her figure gradually approaches to the form of a semicircle, while her apparent diameter diminishes; she is then evidently receding from the earth. As she returns towards the sun, her figure continues to increase and her diameter to diminish, till the moment of her vanishing in his rays; in a few nights after she is again discovered in the evening, towards the west, with her orb nearly full; but in the middle of this interval she must have been in conjunction with the sun, when her figure, could it have been observed, would have been a complete circle, and her diameter the greatest. Advancing towards the east, her figure diminishes as it had increased, while her increasing diameter indicates her approach towards

The planets. the earth, from which she was before receding. In returning towards the sun, her now semicircular figure is still farther reduced, till she again plunges into the sun's rays, under the form of a crescent, with its horns turned to the west, and in a short time reappears in the morning, in the same form and situation as at first; in the intermediate interval, however, she must have been in conjunction with the sun, when she would have been totally invisible, independent of the brightness of the solar rays; her apparent diameter is then also greatest. As she is then nearest the earth, this is termed her *inferior* conjunction; the opposite one, where she is farthest from the earth, and her figure a complete circle, is termed her *superior* conjunction; it is analogous to the opposition of the moon.

Transits of Venus.—It is in the inferior conjunction, when she is between the sun and earth, that she is sometimes observed like a black spot crossing the disk of the sun. And on the observation of these celebrated *transits* of Venus depend the most accurate method we possess of measuring, by means of the sun's horizontal parallax, his distance from the earth, and from this base the real dimensions of the whole solar system. These phenomena, which are real annular eclipses of the sun by Venus, can only happen, like those of the moon, when the planet is at once in her node and in her conjunction, two conditions which are but rarely found united. The transits accordingly, after succeeding each other in the interval of eight years, do not occur again for more than a century, when they succeed each other again during an interval of eight years; and thus they continue. The last transit happened in 1761; astronomers were sent to different countries to observe it, and it is from these observations that the sun's horizontal parallax has been found.

The phases and transits of Venus prove that she is an opaque globular body, like the sun and moon, deriving her light entirely from the sun. Dark spots, like those of the sun and moon, appear occasionally upon her surface, and a careful observation of them has shewn, 1st, That, like these bodies, she has also a motion of rotation on her axis in a period which is estimated at $23^h\ 21^m$, and on an axis inclined to the plane of the ecliptic; and, 2dly, That immense mountains, of which these spots are the shadows, rise from her surface to the astonishing height, as has been supposed, of 15 or 20 miles. From the appearance also of a faint shade of light along her boundary of light and darkness, similar to our twilight, Schroeter supposes that she is surrounded by an atmosphere, whose density differs but little from that of the earth.

Notwithstanding his proximity to the sun, Mercury has been found, by the help of powerful telescopes, to exhibit the same phases as Venus, to have great mountains on his surface, a motion of rotation in $24^d\ 5^h\ 28^m$, and some have even discovered around him traces of an atmosphere.

Superior planets.—The superior planets appear perfectly round at their oppositions and conjunctions, but in their intermediate positions the figure becomes defective on the side opposite the sun, like the moon in the wane; we hence conclude that they all derive their light from the sun. From the motion of the spots of Mars, Jupiter, and Saturn, the fact of their rotation on their axis has been clearly established: Mars revolves in $24^h\ 39^m\ 22^s$, on an axis inclined $1°51'$ to the plane of his orbit, $59°\ 22'$.; Jupiter in $9^h\ 55^m\ 37^s$, on an axis inclined nearly $90°$ to the plane of his orbit; and Saturn in $10^h\ 16^m\ 2^s$, on an axis inclined about $60°$; and what is very singular, these planets, from the observations of their diameters in different directions, appear to be not perfectly spherical, but, like the earth, flattened, and that to a much greater degree in one direction. In each of them, also, the shortest diameter coincides exactly with its axis of rotation; so that, like the earth, the compression is at their poles, and the protuberance at their equators. Mars and Jupiter seem to be surrounded with atmospheres of considerable density. This is indicated in both by the irregular variations of their spots, arising apparently from the agitation of clouds driven about by the wind, but more particularly on Mars, by the great redness of his light; the density of his atmosphere, according to a principle in optics, obstructing, it is supposed, all but the red rays of the sun. Mars is also distinguished by bright spots, which seem to form a luminous zone or belt round his poles, for they augment and diminish in proportion as they are more or less obliquely exposed to the rays of the sun. They are believed to arise from the reflection of his light from the masses of ice which are supposed to surround the poles of the planet, like those of the earth. Besides his variable spots, Jupiter is surrounded with belts or zones, as in Pl. 24. which, though very variable in their number and magnitude, are nearly always parallel to each other and to his equator. The cause of these appearances is quite unknown. Similar belts are observed on Saturn, but no traces of an atmosphere. Of the other planets, Uranus is too distant, and Vesta, Juno, Ceres, and Pallas, too small, to admit of any observation from which either a revolution on an axis, or the contrary, can be inferred.

Secondary planets.—But the most remarkable of all the modern discoveries concerning the planets, is the existence of certain small stars, which continually accompany some of them in their course round the sun, and which have been hence termed their Satellites. Four of these stars are always seen along with Jupiter, and they are easily observed to be continually in motion relatively to the planet. They remain always nearly in a straight line, parallel almost to the plane of the ecliptic; but each night they are ranged upon it in a different order. By comparing their successive positions, it appears that these alternations occur according to a certain law. Each satellite, after advancing a certain distance towards the west of the planet, returns towards it, passes to the opposite side, and after receding to the same distance as before, again returns, overtakes the planet, again advances towards the west, and thus continues to exhibit a perpetual series of oscillations. That satellite which recedes least from the planet is termed the first, the next the second, and so on in the order of their greatest distances. It is natural to think, however, that these oscillations, like those of Mercury and Venus about the sun, are only apparent, and that the satellites really circulate round their

Of comets.

planet, as the moon circulates round the earth. This singular result is confirmed by what happens in the middle of their apparent oscillations. Sometimes, when any of the satellites passes from the eastern to the western side of the planet, it is observed like a spot upon the disk of Jupiter. Another dark spot is also seen accompanying it. In passing again from the western to the eastern side of the planet, the satellites suddenly disappear entirely from our view, and in a short time reappear a little farther toward the east. It was soon conjectured that these disappearances like those of our moon, in opposition, were real eclipses of the satellites; as in passing beyond the planet they entered into its shadow; and that the dark spot that was seen traversing along with them the disk of the planet, was nothing else than the shadow which the satellites projected behind them in passing between the sun and the planet. The observations of one hundred years have fully verified these conclusions, and led to a complete knowledge of the motions of the satellites. The first satellite revolves in $1^d\ 18^h\ 27^m\ 33^s$; the second in $3^d\ 13^h\ 13^m\ 42^s$; the third in $7^d\ 3^h\ 42^m\ 33^s$; and the fourth in $16^d\ 16^h\ 32^m\ 8^s$; and the distance of each satellite, the radius of Jupiter being one, is, 1st, 5.70.; 2d, 9.06.; 3d, 14.46.; 4th, 25.43. In their revolutions round the planet, the satellites are found to obey the same law which governs the planet in its revolution round the sun. Their radii vectores describe round the planet areas proportional to the times. The orbit of the fourth is sensibly elliptical; those of the three first circular; and in all of them the squares of the periods of their revolutions are proportional to the cubes of their mean distances from the planet. From this striking analogy these bodies have been termed *secondary* planets; those round which they revolve being distinguished by the title of *primary*. These secondary planets are very analogous to our moon; like her they enlighten the primary planet in the absence of the sun, and revolve round it according to the same law by which she revolves round the earth. Like the moon, also, they are occasionally eclipsed by the planet. From observations on their surface, the curious fact has also been established, that, like the moon, they have a rotation on their axis, each in the exact period of its revolution round the planet.

The eclipses of Jupiter's satellites, as they happen very frequently, and at the same instant all over the earth, have therefore been employed to great advantage in finding the longitude of places. The tables of their motions have, on this account, been brought to great perfection. The instant, on the meridian of Greenwich, each satellite enters or quits the shadow of Jupiter,—the instant of its *immersion* or *emersion*, as they are termed, is there set down; and by observing the instant at any other place, the difference of time gives the difference of longitude. At sea these observations are impracticable, on account of the unsteadiness of the vessel.

No fewer than seven satellites have been discovered round Saturn, and six round Uranus; as far as they have been observed, they are subject to the same laws as those of Jupiter.

Saturn's ring.—Besides these appearances, which resemble those of the other planets, Saturn presents one, as at Plate 24. Fig. 10. which is quite *unique:* he is surrounded by a broad, thin ring, concentric with himself, and separated from him on all sides by a distance equal to his diameter. This ring has the appearance of an ellipse, of which the form is continually changing. The breadth is observed gradually to diminish; the whole ring disappears and reappears in a short time, when the breadth begins to increase, and continues for a certain period, and then diminishes as at first. By comparing these variations with the positions of Saturn and the Earth, it has been found that the ring is circular, as at Fig. 11. but appears under the form of an ellipse, on account of being more or less obliquely exposed to our view by the revolution of the planet. From the appearance of one or more dark lines along the middle of the ring, and concentric with it, the ring is supposed to consist of two or more rings, quite detached from each other. The following are the dimensions of these rings:

	Miles.
Inside diameter of the interior ring,	146,000
Outside diameter of the interior ring,	184,000
Inside diameter of the exterior ring,	190,000
Outside diameter of the exterior ring,	205,000

The plane of the ring coincides with the plane of the equator of Saturn; and Dr Herschel has discovered that it revolves in this plane on an axis perpendicular to it, and passing through the centre of the ring. The period of this rotation is the same with that of the planet, namely, a little more than ten hours.

The nature and uses of these singular bands are quite unknown; but as the ring disappears when unenlighted by the sun, and when enlightened casts a deep shadow upon the planet, it is concluded that both the ring and the planet are opake bodies, deriving all their light from the sun.

Chap. VI. On Comets.

All the observations that have been made upon the fixed stars concur in placing them, as we have already supposed, at a distance immense in relation to the dimensions of the solar system. Their parallax is totally insensible. The telescope, also, which enlarges the disks of the sun and of the most distant of the planets, has no magnifying effect whatever upon any of the fixed stars, even though we employ the most powerful instruments that have ever been constructed; though we thus discover an innumerable multitude of new bodies, termed *telescopic stars*, which are subject to the same common motion with the rest, and of which the number always increases in proportion as we increase the power of the telescope,—yet as the glare of light with which they are surrounded is thus taken away, the stars seem rather to suffer by this application; and though our telescopes magnify 200 or 300 times,—though the effect therefore is the same as if these bodies were brought 200 or 300 times nearer, as they still shine like brilliant points in the sky, it is impossible, at such immense distances, and with diameters so insensible, that they could be visible to us if they were only enlightened by the sun. It is more natural to think they are like the

Motion of the earth.

Sun, great masses of matter shining with their own light. Another set of bodies, of a different nature, and which we have not hitherto noticed, appear occasionally in the heavens. When first observed they are very small, their light is very faint, and they move very slowly among the stars; by degrees, they increase in brightness and velocity, and after a certain period diminish in the same manner, and at last disappear. Being usually accompanied with a sort of *tail* or *coma*, they have been called *comets*. In ignorant ages they were regarded with terror; but their motions are now followed with interest and curiosity. When observed through a telescope, they seem a mass of vapours, at the centre of which is commonly a nucleus, more or less opake; but some of them have appeared without any sensible nucleus, the stars, it is said, having even been observed through them.

It was long doubted if comets were real stars; they were looked upon as simple meteors, engendered in the air by the influence of certain vapours. All the comets, however, that have been observed, have little or no parallax, which shews that they are far beyond the limits of our atmosphere. Besides, their apparent motions across the stars appear subject to regular laws, by which even their return can be sometimes predicted. It is natural to conclude, that the comets are permanent stars, like the planets, but subject to a different course. From the observations that have been made upon those that have successively re-appeared, it is probable that they move in very eccentric ellipses, approaching much nearer the sun in one part of their course, and receding to a much greater distance in another, than any of the planets. Hence arise those progressive variations which we observe in their brightness, according to their distance from the sun; the latter either inflaming or only enlightening them. As the tail increases as they approach, and diminishes as they recede from the sun, it is probably only an enormous mass of vapours, which the intense heat of the sun raises up. Its length and form are very various; sometimes it is only a few degrees, at others it is more than a quadrant. In the great comet which appeared in 1680, the tail subtended an angle of 70°,—in that of 1618 an angle of 104°.

Chap. VII. Of the Motion of the Earth.

Having in the preceding chapters given an account of the discoveries which astronomers have made concerning the heavenly bodies, it only remains to point out the conclusions to which they necessarily lead. We shall first consider the motion of the earth.

Sect. I. *Of the Diurnal Motion.*

We have already shewn that the phenomena of the diurnal motion, to which all the heavenly bodies are subject, are exactly the same, whether we consider them all carried round the earth, supposed immoveable, or the earth itself to revolve in a contrary direction; we have also endeavoured to obviate the objections to this latter hypothesis which naturally arise in the mind, and to shew that it is even much more natural to admit the motion of the earth, and to regard that of the heavens as only apparent.

Motion of the earth.

The above discoveries confirm this result in a remarkable manner; for we are now certain, *first*, That the heavenly bodies are placed at very different distances from the earth, the sun and the stars being much farther from it than the moon; that the planets move round the sun at different distances, and in different periods; and the comets also in every direction. These circumstances render certain the fact of the insulation of these bodies in respect to each other, and thus strengthen the argument which is drawn from the difficulty of conceiving so many of them, unconnected with each other, impressed at the same time with a common motion.

2dly, The earth is a globe whose radius is not above 8000 miles; the sun, as we have seen, is incomparably greater; if his centre be supposed to coincide with that of the earth, his volume would include the lunar orbit, and extend as far beyond it; if his magnitude were exhibited upon the same scale with those of the planets in Plate 24. his diameter would be two feet. Is it not infinitely more simple to suppose in our little globe a motion of rotation, in which there is nothing contrary to nature, than to imagine the immense mass of the sun to describe every day round us a circumference of many millions of miles, and with a velocity of nearly 200,000 miles in a minute: What power is there in the earth which could balance the tremendous centrifugal force, that would be generated by so rapid a revolution of so great a body? what prodigious force would be necessary to prevent its flying from its centre of motion, like the stone from the sling?

But this is not all; the same difficulties arise in regard to the planets. In Pl. 24. Fig. 6—9. is exhibited their relative magnitudes, and in Pl. 25. their distances from the sun, or their mean distances from the earth. A better idea of these distances may perhaps be formed from the following consideration: Suppose a cannon ball to fly with a velocity of 480 miles an hour,—projected from the sun, it would move onwards for seven years without reaching the orbit of Mercury, the nearest of the planets to the sun,—in seven months more it would arrive at this orbit,—at that of Venus only in fourteen years,—of the earth in nineteen years three months,—of Mars in twenty-nine years two months,—of Jupiter in 100 years, of Saturn in 184 years, and at that of Uranus in 350 years. We must, upon the above hypothesis, suppose the same diurnal motions in all these bodies, and also in the comets and satellites motions exactly proportioned to their distances. Nay, what is much more than all this, we must extend them to that multitude of stars with which the heavens are covered; and all these bodies, whose distance it is impossible to conceive, would turn together every day round an imperceptible point with perfect regularity, and with a velocity that frightens the imagination.

3dly, We have seen that the whole heavenly bodies seem to have another common motion much slower, and in the opposite direction to that of the diurnal, and which, if the earth be immoveable, can only be represented by supposing the celestial sphere in motion round the axis of the ecliptic. Thus, the whole system, composed of so many bodies, differing from each other so much in their magnitudes, mo-

Motion of the earth.

tions, and distances, would be again subject to a general motion, which disappears, if we suppose the terrestrial axis to move round the axis of the ecliptic.

4thly, These arguments are strengthened from analogy, by the discovery of a rotatory motion in all the planets whose surfaces have been sufficiently observed, and in all of them, from west to east, the direction of that which the diurnal motion of the heavens would indicate to the earth,—Jupiter greatly exceeding the earth in magnitude, moves round its axis in less than twelve hours. An observer on its surface would see the heavens revolve round him in that time; yet that motion would only be apparent. Is it not, therefore, reasonable to think, that it is the same with that which we observe on the earth? What confirms in a very striking manner this analogy is, that both the earth and Jupiter, as well as some of the other planets whose rotations have been observed, are flattened at the poles. Though we are ignorant of the exact process by which this figure has been brought about, yet it can hardly be doubted that, in the planets, it is the effect of the centrifugal force. Conversely, therefore, this figure of the earth is almost a direct proof of the operation of a centrifugal force, produced by the earth's rotation. This force should likewise diminish the force of gravity at the equator; and that this diminution does take place, is proved by experiments which have been made on the lengths of pendulums.

Every thing, then, leads us to conclude, *that the earth has really a motion of rotation*, and that the diurnal motion of the heavens is merely an illusion which is produced by it.

Sect. II. *Annual Motion.*

The annual motion of the earth is indicated by proofs as strong and as numerous. In the *first* place, the planets resemble the earth in almost every particular. Like the earth, they are opaque bodies, deriving all their light from the sun. Like the earth, many of them have moons circulating round them; and, like our moon, turning also each of them round its axis in the exact period of its revolution round the planet. The planets also are almost all surrounded with atmospheres; their surfaces are mountainous and irregular, but, upon the whole, globular; and in every instance where the effect is not too minute for our observation, they are, like the earth, flattened at the poles, and bulging out at the equator. There is hardly a case, therefore, where we would say with more propriety that they are all of the same *class*, and thus add the earth to the list of planets. But it is the distinguishing mark of a planet to move round the sun in an elliptic orbit, differing but little from a circle, and at the same time, in every instance where the fact can be ascertained, to turn on its own axis. We are now certain that this latter motion belongs to the earth; and as we have seen that the appearances are exactly the same as if the earth also turned round the sun in an ellipse, this second motion almost follows as a matter of course. But there is still another very remarkable circumstance in which the earth resembles the planets. We have seen that an invariable law connects together their distances from the sun, and the periods of their revolutions; but this law extends to the earth, if we consider it as a planet; for if the proportion be stated,—as the cube of the mean distance of Mercury, 0.387, is to the cube of the earth's mean distance, 1, so is the period of Mercury to a fourth proportional,—this fourth term will be found equal to $365\frac{1}{4}$ days, the exact period of a sidereal year, the time which the sun's motion would indicate for the length of the earth's period, if that motion be ascribed to the earth. The very same quantity results as the fourth term, if the proportion be stated with the distance and period of Venus, of Mars, or any other of the planets; and as it is impossible, where so many numbers are concerned, that this singular coincidence could be the effect of chance, taken along with the above resemblances it amounts almost to a direct proof of the annual motion of the earth.

2dly, If, led away by appearances, we suppose the sun really in motion round the earth, we must also suppose, in order to explain their stations and retrogradations, a similar motion in all the planets. As the planets Jupiter and Saturn move round the sun, and carry all their satellites along with them, we must suppose that the sun, in his motion round the earth, carries in the same manner all the planets, as well as their satellites, along with him. But these various notions are of the same kind with those which the diurnal motion presents, and which, we have seen, are quite illusory. Besides, it seems to be a general law, that the smallest bodies of the solar system turn round the greater. The moon is 49 times smaller than the earth, round which it revolves. The planets Jupiter and Saturn are each of them larger than any of their satellites, or all of them put together; and the whole of the planets and satellites together are nothing equal in magnitude to the sun, the common centre of all their motions. How improbable is it, therefore, that the order of nature should be reversed in the case of the earth, in physical qualities so inferior to Saturn, to Jupiter, or to Uranus. Thus, in every view, the above supposition is inadmissible, and we are again brought back to the motion of the earth as the only solution of all the difficulties. *Lastly*, a direct proof of the annual motion of the earth is obtained from the phenomenon termed the *aberration of light*, or *the aberration of the fixed stars*. This is a very slight motion to which the stars are subject, and which is explained most satisfactorily, and in its minutest details, by ascribing it to the motion of light combining itself with the motion of a spectator on the earth, and thus producing in the stars a slight deviation from their true places, but which is quite inexplicable on any other hypothesis.

Collecting all these evidences, then, and considering also that there is no appearance inconsistent with it; and that there is not in nature any other way in which it could have been indicated, it may be reckoned as a fact beyond all question, *that the earth has really in space a motion of revolution round the sun, as well as of rotation on its axis.*

Gravitation.

Chap. VIII. Of the Principle of Universal Gravitation.

Thus the observations of modern times have completely verified the beautiful theory which we noticed at the conclusion of Part I. But when we consider a system composed of so many bodies turning round a great centre of heat and light, themselves also the moveable centres of the perpetual revolutions of inferior systems; when we consider, too, that these bodies, however various their distances from the centre, and the periods of their revolutions, are all governed in their motions by the very same laws—it is impossible not to recognise the operation of some more general cause which actuates the whole.

Can these bodies, then, though separated by distances so immense, still have any effect upon each other? Let us consider what happens on our own planet. There is no power on the earth whose operation is so constant and so universal as that of gravity. It is felt on the highest mountains and in the deepest cavities, and, whatever be its nature, its effect invariably is, when nothing opposes it, to make all bodies descend in straight lines directed towards the centre of the earth. It is thus that the rain is precipitated from our atmosphere, carried through all the windings of our rivers, and finally deposited in the ocean, where it is no sooner raised up by the opposite force of evaporation, than it is again precipitated by the effect of this ever-working and all-powerful agent. The most familiar fact in nature, therefore, is that of one mass of matter acting with great intensity upon another at a distance; and this force, if its influence could be supposed to extend to the moon, and also to exist on the planets, and even on the sun, extending from the former to their satellites, and from the latter to the remotest extremities of the system, seems admirably calculated for drawing these bodies each to the centre of its motion. If a force of this kind, however, operated alone, their motions, like the fall of a stone, would soon terminate by their arrival at their centres of attraction; but we often observe on the earth the power of gravity combined with other forces, so that there arise from their joint influence motions very varied, and, in some cases, like those of the planets, perpetual. Thus the rain, precipitated by the force of gravity, and carried into the sea, is raised up by the force of evaporation; and, being transported by the winds, it is again precipitated in the same place, and is thus made, by the combined effect of these forces, to describe a species of re-entering curve. Thus a balloon, instead of descending, remains sometimes suspended, and sometimes ascends with great rapidity. Thus, also, a body projected from the hand, or from a cannon, rises into the air, and then descends, describing a curve line, which has been found, both by theory and experiment, to be one of the conic sections termed *the parabola*. May not then the force of gravity be so combined with some other as to make the planets describe another of the conic sections, namely, *the ellipse?* The possibility of this combination is made evident by a very simple experiment. Suspend a ball by a long thread directly over, and at the same height with a candle or other object,—if the ball be withdrawn to some distance from the candle, the centre of its attraction, it will, when left to itself, descend directly towards the candle, and, if the candle were removed, would continue for a long time to oscillate backwards and forwards; but withdraw the ball to the same distance again, and project it in a direction at right angles to that in which it would oscillate by the combined effect of the two forces of projection on the one hand, and gravity towards the centre, on the other, it will then describe round the candle circles or ellipses of various magnitudes and eccentricities, according to the force of projection. As it continues, however, to revolve, it will gradually diminish in velocity, approach to and finally settle in the centre of attraction; but as the force of gravity never diminishes, this retardation must arise from the resistance of the air and the friction of the materials, and if these obstacles were removed, it is certain, from the principles of mechanics, that the body would continue for ever to revolve round the candle in a manner somewhat similar to the revolution of a planet round the sun.

To verify the supposition of the planets, comets, and satellites being actuated by similar forces, astronomers have considered them as all gravitating bodies, which have been launched into space, at a certain distance from a point to which they have been at the same time endowed with a tendency to approach. They have then decomposed their motions, and valued separately the effects of the impulse which makes them circulate, and that of the force which retains them in their orbit. From the laws of Kepler, which are established by observation, they have concluded, by a rigorous calculation, aided by a refined analysis, *first,* That the force which solicits the planets is directed towards the centre of the sun; this is derived from the law, that the areas described by the radius vector of every planet are proportional to the times: *Second,* That the force which animates the planets and comets is in the inverse ratio of the squares of their distances from the sun; this is derived from the second law, that the orbits of the planets and comets are conic sections, of which the sun occupies one of the foci: *Third,* That it is the same force which animates all the planets and comets; this is derived from the third law, which connects the distances of the planets and comets with the periods of their revolutions.

In this manner the observations of Kepler lead directly to the knowledge of the general force which actuates the bodies of the solar system, and which has been called *solar attraction.*

The motions of the satellites presenting similar phenomena, and being equally subject to the laws of Kepler, it results from them that every system of satellites is attracted towards its planet by a force reciprocally as the squares of their distances, and therefore similar to the solar attraction.

It has also been established, by the comparison of the celestial phenomena, that all the particles of matter have a mutual attraction for each other, in the direct ratio of their masses, and the inverse ratio of the squares of their distances. This great and simple law of nature, which finely harmonizes the hea-

Gravitation.

venly motions, was discovered by Newton. It is termed the principle of *universal gravitation.*

But it will receive additional confirmation if all the celestial phenomena can be deduced from it as necessary consequences; and this is the case in a most remarkable manner. In thus following out the principle in all its details, the greatest difficulties have been experienced. Observations, in many instances at variance with theory, could not be reconciled with it, though all the circumstances of each case were weighed with the utmost attention; doubts were raised as to the efficacy of the principle of gravitation, and the agency of other forces was introduced for the purpose of explaining the appearances; but at last it was discovered that the calculations had not been rigorously exact, and finally the whole of those discrepancies yielded to the repeated attacks of a more improved analysis. "Such," says La Place, alluding to the principle of gravitation, "has been the fate of this brilliant discovery, that every difficulty that has arisen has only furnished for it, a new subject of triumph; and this is the most indubitable characteristic of the true system of nature."

Disturbing forces.—Since the principle of attraction is universal throughout the system, the planets and satellites, while they are attracted each to its centre of revolution, must at the same time attract each other; and from these *disturbing* forces, as they are termed, arises the deviation of the planets and satellites from the true elliptic motion, as well as those secular inequalities of which observation has only indicated the existence, but could not have developed the laws. Hence also is deduced one of the most important conclusions in Astronomy, namely, the stability of the system.

When it was discovered that the orbits of the planets were subject to a perpetual change, that the solar ellipse was gradually approaching to the form of a circle, and its plane to the plane of the equator, it was thought that the system contained within itself a principle of dissolution, and, for its perpetual existence, would require occasional retouches from the hand of its great author. It now appears, however, that all these changes are oscillatory,—that after proceeding for certain periods in one direction, they return in the opposite,—and after continuing in it for the same periods, again proceed as at first. Though the system, therefore, is subject to a perpetual change, its mean state is that of a perpetual equilibrium; from this it no sooner deviates to a certain extent, than the error, by an admirable provision, corrects itself, and the system is brought back to its mean state; but the impulse thus given carries it a little farther, the error is again corrected, and the system again returns to the point, about which it will certainly thus continue for ever to oscillate, unless it be disturbed by some external violence.

The precession of the equinoxes is fully accounted for by the principle of universal gravitation; it is found to arise from a real conical motion of the earth's axis, produced by the action of the sun and moon upon the bulging mass of matter accumulated at the equator.

The singular law by which the whole of the satellites turn on their axis, in the exact period of their revolution round their planets, so as continually to present to them the same face, is another consequence of the same principle; and on it also the phenomena of the tides in all their details are dependent. In short, there is no appearance in the whole system of the sun, the planets, and the satellites, which is not completely accounted for by this great law of nature, and deduced from it with admirable precision.

"The motion of the earth," says La Place, "which had obtained the assent of astronomers, from the simplicity with which it explained the celestial phenomena, has received, from the principle of gravitation, a new confirmation, which has carried it to the highest degree of evidence of which physical science is susceptible." After shewing that this hypothesis reduces to the least possible the number of assumptions on which it is built, by only supposing the planets to have received a single impulse in a direction not passing through their centres of gravity, he proceeds: "This principle has, besides, the advantage of connecting this theory with all the celestial phenomena. Without it, the ellipticity of the planetary orbits, the laws which the planets and comets follow in their revolutions round the sun, their secular and periodic inequalities, the numberless inequalities of the moon, and of the satellites of Jupiter, the precession of the equinoxes, the rotation of the terrestrial axis, and, lastly, the ebbing and flowing of the sea, would only be insulated and unconnected phenomena. It is really a circumstance deserving our admiration, the manner in which all these phenomena, at first sight so unconnected, flow from one law which connects them with the motion of the earth; so that this motion once admitted, we are conducted by a series of geometrical reasoning to these phenomena. Each of them furnishes, therefore, a proof of its existence; and if we consider that there does not exist a single phenomenon which cannot be referred to the law of gravity, and that this law determines with the greatest exactness the positions and motions of the heavenly bodies through the whole of their course, there will be no reason to fear that its truth will be questioned in consequence of any phenomena hitherto unobserved. And, finally, when we see that Uranus and its satellites, lately discovered, obey and confirm the same law, it is impossible to refuse assent to these proofs, and not to allow that nothing in natural philosophy is more completely demonstrated than the motion of the earth and the principle of universal gravitation, in proportion to the masses, and inversely as the squares of the distances."

Having thus ascended to the first cause of the phenomena, astronomers have, by descending to its effects, discovered many things which observation alone could not have indicated. In this manner they have deduced what seems at first so utterly beyond the reach of human knowledge, the masses and densities of the planets. If the quantity of matter in the earth be denoted by 1, the mass of the sun is found to be 334,000, and of the planets Mercury 0.165, Venus 0.89, the Moon 0.025, Mars 0.087, Jupiter 312.1, Saturn 97.70, Uranus 16.80; and if the density of water be 1, that of the sun is $1\frac{2}{15}$; Mercury $9\frac{1}{6}$, Venus $5\frac{3}{4}$, the Earth $4\frac{1}{3}$, the Moon $5\frac{1}{2}$, Mars $3\frac{2}{7}$, Jupiter $1\frac{1}{23}$, Saturn $0\frac{11}{34}$, Uranus $0\frac{99}{100}$. Hence also they have deduced the laws of those inequalities in the motions of the planets which only recur after the lapse of ages, and have thus been enabled to give to astronomical tables a degree of precision almost equal to observation, and to tell in this manner the *state of the heavens*, both in the ages that are past and in those that are to come. Astronomers have thus, in the words of Biot, "decomposed the system of the world, reduced it to its single element, and recomposed it again." In this view, astronomy is the noblest monument of human genius, and the system which it discloses, bearing evident marks of wisdom and design, must be the work of infinite intelligence and almighty power.

Chap. IX. Of the Fixed Stars.

Let us now extend our view to the region of the fixed stars, from which every thing thus leads us to detach the system of the sun and planets, to which we ourselves belong.

Immense distance.—We have already seen, that, to measure the distance of an inaccessible object, it is necessary to transport our instruments to different positions, and that any base that we can obtain on the earth is too small to determine with accuracy the distance of the sun; this method is still more imperfect in regard to the more distant planets and the comets; while it fails altogether in the case of the fixed stars. As we are now certain, however, that the earth, (Pl. 23. Fig. 10.) moves round the sun, S, at a mean distance of 95 millions of miles, it is equally certain, that every six months we are transported, along with our instruments, from E to F′, over double this space; so that were the distances of the stars within the bounds of our conception, it would certainly be indicated by this great change in our position. But though we are thus carried twice every year from the one extremity to the other of a base of 190 millions of miles, over a space which a cannon ball would hardly describe in 40 years, and from the one end of which its report would only be heard at the other after an interval of more than 25 years; and though the precision of modern instruments is such, that the angle E S′, (which is termed the *annual* parallax of the stars,) would certainly be perceived, though it amounted but to the half-millionth part of the circumference, yet astronomers have never been able to detect, from this ample base, the slightest change in the position of any of the stars; we conclude, therefore, that their distance from the earth bears no sort of proportion even to the diameter of the earth's orbit, or, at any rate, that they are at least 100,000 times farther off than the sun. Thus these bodies seem to recede the farther, the nearer we approach to a knowledge of their real situation.

Supposed to be suns.—Since, at this enormous distance, the stars, whose diameters are insensible, still shine with such lustre, it is impossible to doubt that they are luminous of themselves, and that they are so many suns spread though the regions of space.

It is natural also to think that they do not exist there for nothing, but rather that they are intended to give light and heat each to a system of planets circulating round them.

Subject to changes.—The stars must undergo great changes, since they are sensible at so great a distance. Many of them are subject to periodical variations in brightness; some new stars have appeared; and some which were once observed have disappeared entirely from the heavens; some also have appeared for a short time, and, after increasing in brightness, have diminished in the same manner, and finally disappeared. Such was the star that appeared in 1572 in the constellation of Cassiopeia. It became suddenly so conspicuous as to exceed the brightness of Venus or Jupiter, and could be seen at mid-day in the meridian; by degrees it diminished, and finally disappeared six months after its first appearance, without changing its place. Its colour in these intervals underwent great variation; it appeared at first of a bright white, like Venus; then reddish, like Mars, and lastly, of a white lead colour like Saturn. These appearances seem to indicate great conflagrations upon these bodies.

Seem to be in motion.—Though the stars appear to us in repose relatively to each other, they may not be so in reality; for, on account of their great distance, they might move through spaces of inconceivable extent, without our perceiving it, even with the finest instruments. In fact, a slow motion has been observed in some of them, which is represented by supposing the sun himself, along with all the planets, in motion toward the constellation Hercules. It is probable, therefore, that these systems of suns and planets move round each other in the same manner as the planets round their suns, and the satellites again round their planets.

At different distances.—It is impossible to believe that these suns or stars are all at the same distance from the earth; it is more natural to think that those which are largest and brightest are the nearest, and that those of inferior magnitudes are proportionally farther off. What are we to think, then, of the distances of those stars which are invisible to the naked eye, but appear in great numbers through a telescope; and, again, of those which are only visible with telescopes of the most powerful kind? Light moves with inconceivable rapidity, reaching us from the sun in eight minutes; it is not unreasonable to suppose that these stars may be so far distant that light would take many years in travelling from them to the earth, and not impossible that there may be some of them whose light has not yet reached us, and that the light of others which may have long since ceased to exist still shines on the earth.

Nebulæ.—Even to the naked eye the stars do not seem uniformly scattered over the heavens, but are arranged in groups, and in many cases massed together, so as to have the appearance of a *nebula*, or cloud of light. The same thing is observed through the telescope; innumerable multitudes of stars, formerly invisible, are now distinctly perceived; what appeared to be nebulæ, now seem an innumerable collection of distinct stars, and of other nebulæ, of which the distinct stars are again observed by more powerful instruments, as well as another set of nebulæ still; vast collections of nebulæ also are discovered which are invisible to the naked eye. These nebulæ are sup-

Fixed stars. posed by astronomers to be collections of suns, revolving, perhaps, round each other in the same manner as the suns of which they are composed, each carrying along with it its system of planets and satellites. That large zone of light, which stretches across the heavens, and is termed the *milky way*, is supposed to be a nebula of this kind, to which our sun and planets belong, and which appears to us so large on account of our proximity to it. Its light is owing to the immense multitude of stars of which it is composed; within a portion of it, 15° long and 2° broad, Dr Herschel counted no less than 50,000, and suspected that there were as many more, which, from the want of light in the telescope, he only observed now and then.

Since the number, then, of the stars in the nebula which is nearest us is so incalculable, and their distances so great, that we are certain a cannon ball, travelling at the rate of 400 miles an hour, would not reach even the nearest of them in two millions of years, what can we think of the number and distances of the stars in those multitudes of nebulæ which appear, even in the finest telescopes, only as masses of light! The imagination is lost in contemplating these extremes of extent; and the more we reflect, the more impossible is it to fix, or even to conceive, bounds to the universe.

Whether or not the stars be suns, each enlightening its system of planets and satellites, it is surely very probable that the planets of our own system are inhabited by animated beings;—for as it is certain that the sun imparts both light and heat to the planets as well as to the earth, and as his influence gives birth to the animals and plants which cover the earth, "analogy," as La Place observes, "induces us to believe that it produces similar effects on the planets; for it is not natural to suppose that matter, of which we see the fecundity develope itself in such various ways, should be sterile upon a planet so large as Jupiter, which, like the earth, has its days, its nights, and its years, and on which observation discovers changes that indicate very active forces. Man, formed for the temperature which he enjoys upon the earth, could not, according to all appearance, live upon the other planets; but ought there not to be a diversity of organization suited to the various temperatures of the globes of this universe? If the difference of elements and climates cause such variety in the productions of the earth, how infinitely diversified must be the productions of the planets and their satellites. The most active imagination cannot form any just idea of them; but still their existence is extremely probable.

Explanation of Plates.

Plates 21. 22. and 23. Fig. 1—11. illustrate the appearances and motions of the Heavenly Bodies, and are sufficiently explained in the different parts of the treatise from which the references are made.

Plate 23. Fig. 12. is the representation of an ingenious Apparatus, contrived by Mr Kerr, optician in Edinburgh, for the purpose of exhibiting a popular view of the motions of the planetary bodies round the sun. A is the sun; B, mercury; C, Venus; D, the earth, with the moon; E, Mars; F, Jupiter, with his four satellites; G, Saturn, with his satellites; and H, Uranus, or the Georgium Sidus, with his satellites. Fig. 12. is a front view of the apparatus. Fig. 13. is a side view, and will afford a distinct notion of its construction. I K is a pillar which supports the whole apparatus. Each of the planets, which have the same letters of reference as in Fig. 12. is attached by an arm to the axis L, which is turned by the winch M; but the immediate connexion is by a small arm which moves on the extremity of the larger arm, projecting at a right angle. When the axis is turned round, the planet by its weight is always in a perpendicular position, and in this way describes an elliptic figure, which is its true orbit. The moon attached to the earth, and the satellites of the other planets being connected with their centres of motion, in the same way, perform similar revolutions in similar orbits.

Plates. Fig. 14. is an Apparatus invented on the same principle, by the same ingenious artist, for illustrating the change of seasons. A is the sun; B B B B is the earth in different positions of its orbit; and N S is the north and south. C D is an arm which is turned on an axis; and to the extremity of this axis the earth, B, is hung by a shorter arm, so that when the axis to which the longer arm is attached is moved round, the ball representing the earth is always suspended in a perpendicular position; and from the inspection of the different positions of the earth expressed by the dotted lines, it will appear that different parts of it are illuminated and heated at different periods of its annual revolution, thus producing the diversity of seasons. The dotted line, E F G, marks the elliptical orbit of the earth.

Plate 24. Fig. 1. exhibits a view of the Phases of the Moon, or her appearances in different positions in her revolution round the earth, from new to full moon. Fig. 2. represents the appearances of the moon in a contrary order, or from the full to the change. Fig. 3. represents the appearances of the sun in eclipses. Fig. 4. is an annular eclipse, in which a rim of light surrounds the dark body.

Fig. 5. is a view of the Moon in her mean libration, according to the observations of Riccioli and other astronomers. Fig. 6. 7. 8. 9. represent the relative magnitudes of the planets, with the diameters of each in English miles. Fig. 10. a view of Saturn, his belts, and ring, as seen from the earth. In this oblique view the ring appears elliptical; but when seen above the plane of his orbit, as at Fig. 11. it is circular. Fig. 12. a Comet.

Plate 25. Fig 1. is a representation of the relative dimensions of the Orbits of the Planets, the positions of their aphelia and perihelia, and their mean distances from the sun in millions of miles. Fig. 2. exhibits the inclinations of their orbits.

INDEX.

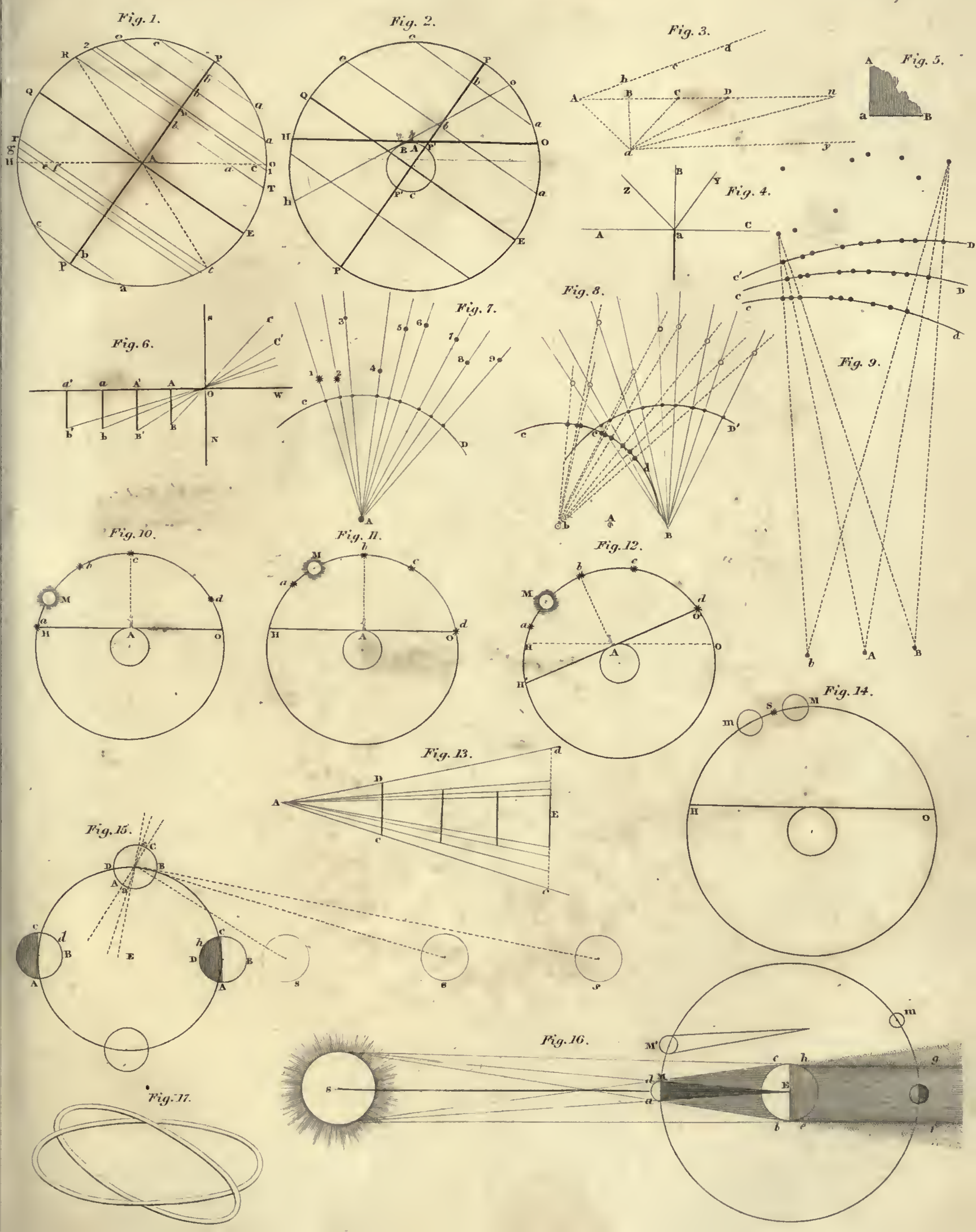


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 10.
Fig. 11.
Fig. 12.
Fig. 13.
Fig. 14.
Fig. 15.
Fig. 16.
Fig. 17.

Fig. 1.

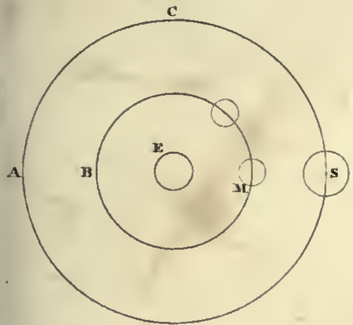


Fig. 2.

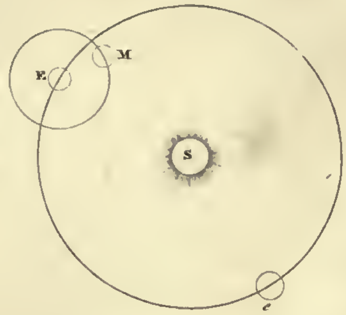


Fig. 3.

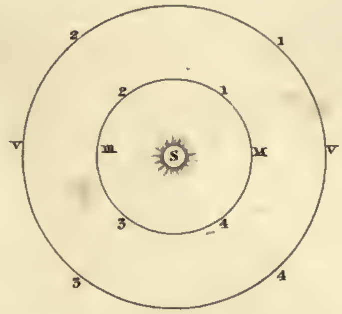


Fig. 4.

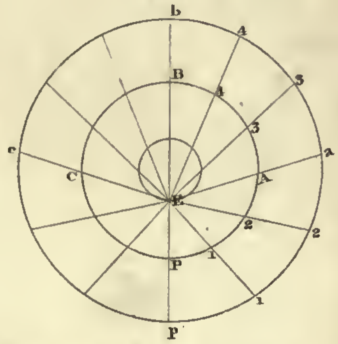


Fig. 6.

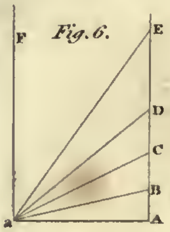


Fig. 5.

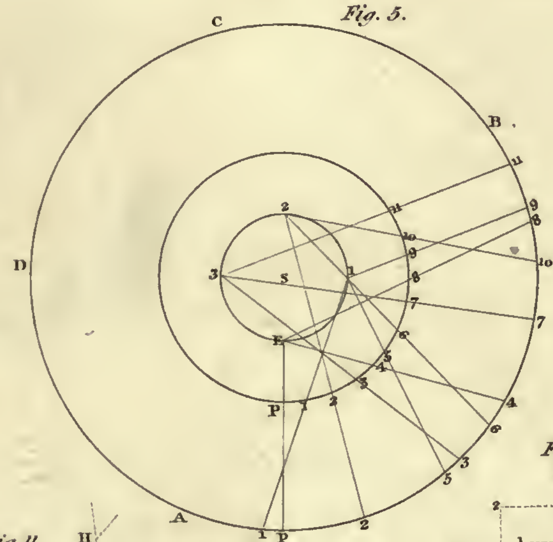


Fig. 8.

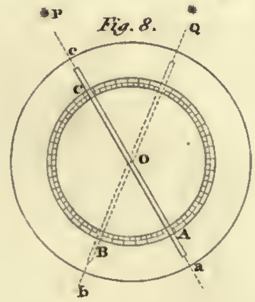


Fig. 9.

Fig. 7.

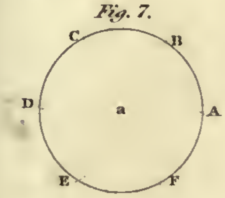


Fig. 13.

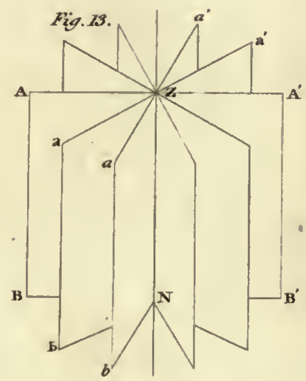


Fig. 10.

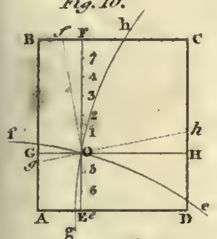


Fig. 11.

Fig. 12.

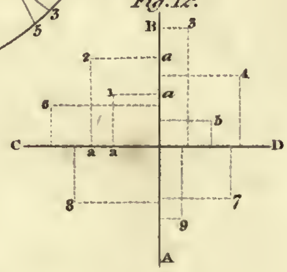


Fig. 14.

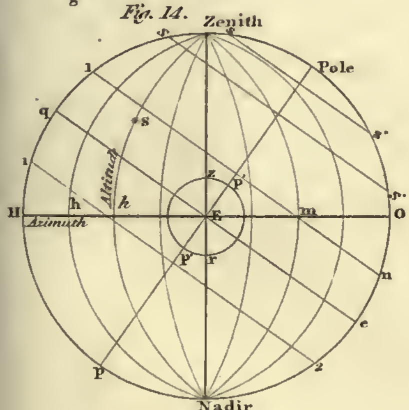


Fig. 15.

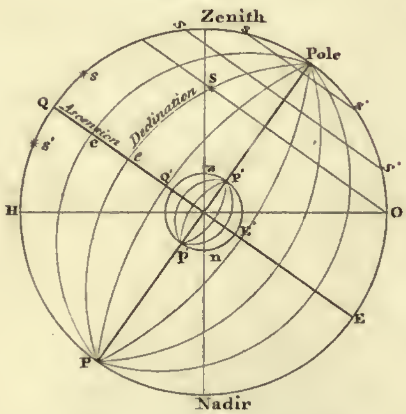


Fig. 16.

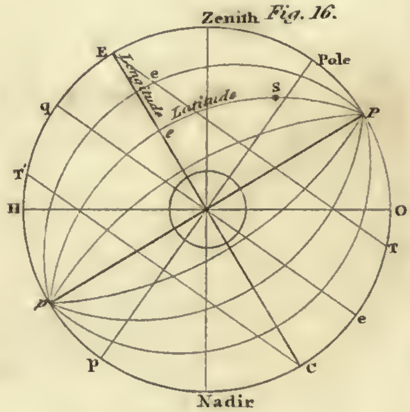


Fig. 18.

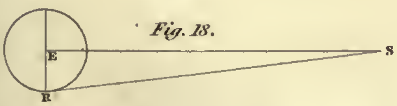


Fig. 17.

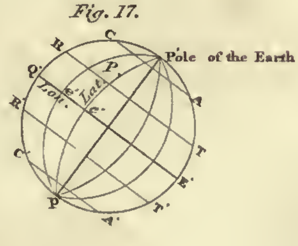


Fig. 20.

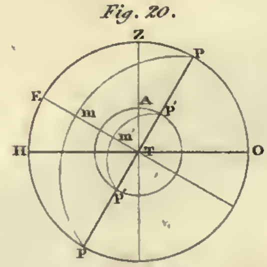
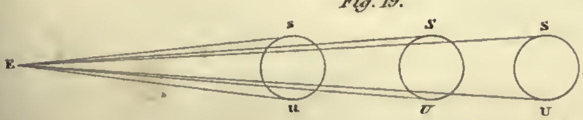
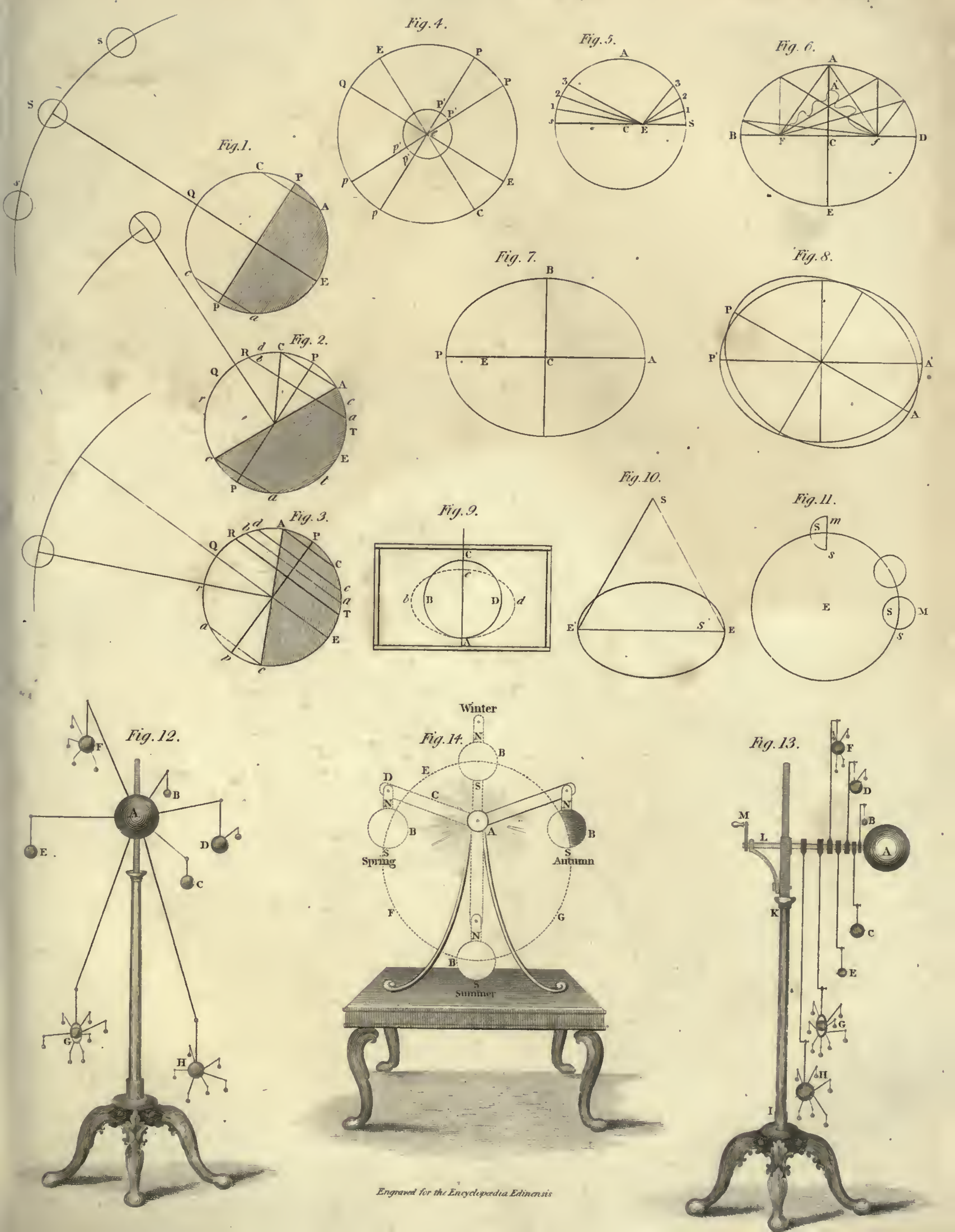


Fig. 19.





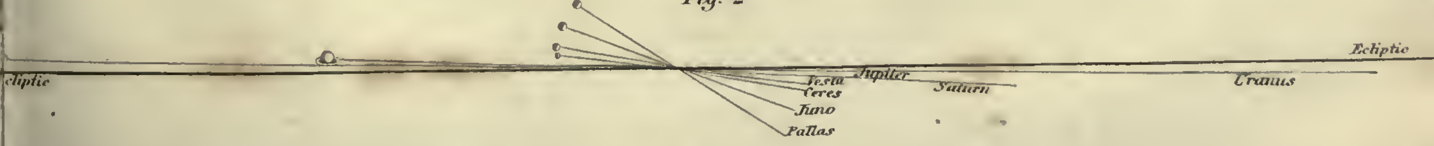
Engraved for the Encyclopædia Edinensis

1st Quarter
Last Quarter
Phases of the Moon
Full Moon
Fig. 1. Earth
New
New
Fig. 2. Earth
Full
Last Quarter
Fig. 4.
Eclipses
Fig. 5.
Saturn 79042.
The Telescopic appearance of the Moon
Fig. 12. Comet.
Fig. 6.
Jupiter 89170.
Saturn & his ring.
Fig. 8.
Mercury
7687 Venus
7912 The Earth
4189 Mars
Juno
Vesta
Ceres
Pallas
Fig. 7.
Uranus 35112.
Fig. 10.
Saturn & his ring.

Fig. 1.

Orbit of Uranus
Saturn
Aphelion
Perihelion
Aph.
Path of a Comet
Orbit of Juno
Venus
Mars
Ceres
Jupiter
Orbit of Pallas
Mercury
the Earth
Vesta
Saturn
Peri.
Jupiter
Aphelion
Perihelion

Fig. 2



Ecliptic
cliptic
Vesta
Jupiter
Ceres
Saturn
Juno
Pallas
Uranus

ASTRUC, John, an eminent French physician, was born at Sauve in Languedoc, in 1684, was educated at the university of Montpellier, and having passed through some inferior degrees, was created, in 1703, doctor of medicine. He was first known to the public in a controversy on the subject of digestion, in which he maintained, that this process depended on a peculiar fermentation, in opposition to the doctrine of trituration, or mechanical action, which was held by other physiologists. In 1710 he was appointed professor of anatomy and medicine at Thoulouse; and in 1717 he succeeded to the medical chair at Montpellier, and acquired great reputation by his lectures. The fame of Astruc procured for him an invitation from the king of Poland to become his physician; but after a short abode with that monarch, he returned to France, fixed his final residence at Paris, was appointed physician to the king, and preferred to the professorship of medicine in the Royal College. In this conspicuous station, his talents, learning, and medical skill, found ample scope; and the celebrity of his lectures attracted crowds of students, foreigners as well as natives, from all quarters. Astruc was the author of numerous works, chiefly connected with medical subjects; his Treatise on Female Diseases still retains considerable reputation; and, at the venerable age of 82, he closed, in 1766, an active, honourable, and useful life.

ASTURIAS, two provinces of Spain, formerly distinguished by the names of Asturia of Oviedo, and Asturia of Santillana, but now united into a principality, from which the eldest son of the king derives the title of Prince of Asturias. The bay of Biscay on the north, Gallicia on the west, and the kingdoms of Leon and Castile on the south and east, form the boundaries of the principality, which includes at least 700 square leagues of the most mountainous district of Spain.

Calcareous rocks, as secondary limestones, full of animal remains, some of which are excellent marbles, chalk, marl, and gypsum, are the prevailing strata in many regions of the Asturias. Some indications of coal have been observed; and ores of copper, iron, lead, and cobalt, have been wrought, but to a limited extent. Many districts are covered with thick and extensive forests of valuable timber trees. The climate is moist, and heavy rains are frequent.

The population of the Asturias is estimated at 350,000. The ancient inhabitants presented a most formidable opposition to the Romans; and while the rest of Spain was held in subjugation by the Moors, their bravery and perseverance enabled them to preserve their independence, contributed to the final expulsion of the invaders, and procured from their grateful countrymen the honourable appellation of *illustrious mountaineers*. The present race is characterized by simplicity of manners and probity of life. The labours of husbandry are chiefly confined to pasturage. Large herds of cattle, and numerous flocks of sheep, are reared in the mountainous districts; but in less elevated situations, wheat, barley, rye, and different kinds of fruits, are cultivated. Oviedo, Santillana, and St Andero, are the chief towns, besides which, sea-port towns of inferior note are numerous; but the province affords few examples of great commercial activity.

ASYLUM, from the Greek, and signifying a sanctuary, is a place of refuge destined for the protection of criminals, slaves, and debtors. Such sanctuaries have been sanctioned by legislative authority both in ancient and modern times; and to the places usually selected for this purpose, as temples, altars, tombs of distinguished personages, churches, and palaces, a high degree of veneration was attached. The temple, the altar of burnt-offerings, and the six cities of refuge were the chief sanctuaries among the Jews. The famous temple of Diana at Ephesus was a place of refuge for debtors; and the tomb of Theseus afforded a similar sanctuary to slaves. Fugitive slaves, debtors, and criminals of all descriptions, found an asylum in Rome, on a spot chosen by Romulus, between the Capitoline and Palatine mounts. This place of refuge was established and encouraged from political considerations, and for the purpose it is said of adding to the population of the rising city.

Immunities of the same nature were granted to Christian churches in the time of the emperors Honorius and Theodosius, and were afterwards extended to monastic establishments. To a certain extent, and in particular cases, they are preserved in Roman Catholic countries. But in Britain they were entirely abolished at the reformation; and the only sanctuaries protected by law are the verge of the court in England, and the ancient palace of Holyrood-house in Scotland; but the privilege is altogether limited to insolvent persons.

ASYMPTOTE, a geometrical term, applied to a line which continually approaches nearer to another line; but although both lines be indefinitely produced, they never meet. See *Conic Sections*, under Mathematics.

ATALANTIS. See Atlantis.

ATCHIEVEMENT, or Achievement, a term in Heraldry, which denotes the arms of a person or family, along with the external ornaments of the shield, as the helmet, mantle, crest, &c.

ATE, the goddess of discord, according to ancient mythology. The name is derived from the Greek, and signifies *to do hurt*, and she was regarded as the author of all evil. She was the daughter of Jupiter, who was enraged at the dissensions which she excited in heaven, seized her by the hair, and swearing that she should never return, threw her headlong on the earth. This fabulous story teaches that no evil can befal man without the permission of providence, which is supposed to be couched in the representation of Ate being the daughter of Jupiter, and her banishment to the earth as expressive of the awful effects of divine justice among mankind.

ATHAMANTA, Spignel, a genus of plants belonging to the Pentandria class, and to the natural order of umbellated plants.

ATHANASIA, Goldilocks, a genus of plants belonging to the Syngenesia class.

ATHANASIAN CREED, a summary or confession of faith, which was long ascribed to Athanasius, bishop of Alexandria, who flourished in the 4th century. But Dr Waterland supposes, that Hilary, bishop of Arles, is the author of this formulary, which, for more than two centuries, bore the name of an *Exposition of the Creed*, or, simply, the *Catholic Faith*; but as it accorded with the doctrines maintained by Athanasius concerning the Trinity and incarnation, in opposition to the Arians, it received its present appellative designation. See *Critical History of the Athanasian Creed.*

This creed was generally admitted in France about the middle of the 9th century; a hundred years later it was received in Spain and Germany; and satisfactory testimony has been adduced that it was sung alternately in the churches in Britain in the 10th century. About the same time it was adopted in some parts of Italy; but it was not till the early part of the 11th century that it was received at Rome.

ATHANASIUS, St. the zealous defender of the faith against the Arians, was a native of Egypt, and flourished in the 4th century. No record is preserved of his early life, of the progress of his studies, or of the extent of his attainments. But, when he was only a deacon of the church, he accompanied the bishop of Alexandria as his secretary to the council of Nice, which met in 325; and by the force of his arguments, and the power of his eloquence, eminently distinguished himself in the rising controversy with Arius and his followers. In the succeeding year he was nominated to the see of Alexandria, and became the intrepid defender of the catholic doctrine of the Trinity against the Arians; and although he was five times driven into exile, his zeal and ardour in the cause which he had espoused remained unabated. By the intrigues of his adversaries, or the wavering caprices of absolute authority, he was banished by one emperor and restored by another, and oftener than once his abdication and restoration proceeded from the mandate of the same sovereign. During one period of his exile he spent six tedious years in the desert of Thebais. He died in tranquil possession of his see in the year 373. The Historian of the *Decline and Fall of the Roman Empire* thus characterises Athanasius: "Amidst the storms of persecution, he was patient of labour, jealous of fame, and careless of safety; and though his mind was tainted with the contagion of fanaticism, Athanasius displayed a superiority of character and abilities, which would have qualified him much better than the degenerate sons of Constantine for the government of a great empire.——His unpremeditated style, either of speaking or writing, was clear, forcible, and persuasive." The works of Athanasius were printed in 1600 and in 1627; but the most splendid edition was published by Bernard Montfaucon, in three volumes folio.

ATHEISM, from the Greek, and signifying *without God*, is usually defined, the disbelief of a Deity, or of the existence of an intelligent first cause. But the appellation of *atheist* is of more indefinite application. It is not only ascribed to those who are unable to trace the marks of wisdom and design in the universe, which have led all rational inquirers to the acknowledgment of a Supreme Being, but to those who assert that the works of creation afford no such evidence—to those who admit the existence of a creative power, but deny that he is possessed of moral attributes—to those who believe in an evil first principle,—and to those who are attached to pagan idolatry, and to polytheism, or the worship of many gods. It has been doubted whether any man, in the full use of his intellectual powers, ever seriously maintained the disbelief of the existence of a Supreme Being; and where such sentiments have been openly avowed, they have been charged to pride, affectation, or some strange aberration of the mental faculties: "Though a smattering of philosophy," it has been well remarked by Lord Bacon, "may lead a man into atheism, a deep draught will certainly bring him back again to the belief of a God and providence." See Religion. The reader who wishes to be familiar with the arguments which are drawn from the works of nature for the being and attributes of God, may consult with advantage Derham's *Physico-Theology*, Ray's *Wisdom of God*, Paley's *Natural Theology*, and Fenelon's *Demonstration of the Existence of God*, &c.

ATHELING, a Saxon denomination signifying *noble*, was applied by the Anglo-Saxons to the presumptive heir to the crown. This honourable appellation was first conferred by Edward the Confessor on Edgar, to whom he was great uncle, as a mark of distinction, and an expression of his intention that he was destined to succeed him on the throne.

ATHELSTAN, a king of England, of the Saxon race, was the natural son of Edward the elder, and grandson of Alfred, assumed the sovereignty in 925, and reigned 16 years. The liberal and enlightened policy of this prince appears conspicuous in the distinguished privileges assigned to those who were engaged in commercial affairs, and the high consideration in which mercantile intercourse was held. It was formally enacted, that any merchant who had accomplished three voyages on his own account beyond the British channel, should be entitled to the rank and dignity of a thane or gentleman.

ATHENÆA, derived from *Athene*, the Greek name of Minerva, were public festivals celebrated by the ancient Greeks, in honour of that goddess.

ATHENÆA, a genus of plants, belonging to the class Octandria.

ATHENÆUM, a public place of resort, first established at Athens, and dedicated to Minerva. Edifices of this description were constructed in the form of an amphitheatre, and they were frequented by poets and orators, for the purpose of declaiming and reciting their works to the assembled people. A celebrated structure of the same kind was erected by Adrian at Rome; and in modern times a similar denomination is applied to certain literary institutions, where those who are associated for their support are accommodated with newspapers and periodical publications, or have the advantage of books from libraries of a miscellaneous nature, and sometimes of hearing popular lectures on scientific subjects.

ATHENÆUS, a mathematician, who flourished about 200 years before the Christian era, and composed a Treatise on Mechanics, which is yet extant, and forms part of the works of ancient mathematicians, printed at Paris, in folio, in 1693.

ATHENÆUS, a physician who lived about the commencement of the Christian era, and was the founder of the *pneumatic* sect of philosophers. He rejected the prevailing opinion, that fire, air, water, and earth are the true elements of matter, which, he maintained, are derived from heat, cold, moisture, and dryness, their qualities. But to this list he added a fifth element, which he denominated *spirit*, and from this arose the distinctive appellation of the sect. To the agency of this spirit he ascribed the pulsation of the arteries.

ATHENÆUS, a Greek grammarian, was a native of Egypt, flourished in the early part of the third century, and, from some doubtful passages in his writings, it is supposed lived to a great age; but no record of his life is preserved. Numerous works have been ascribed to the labour and industry of Athenæus, among which are specified, "A History of the Kings of Syria," and "An Account of the Illustrious Commanders of Armies;" but the only authentic work which has survived the wrecks of time, and has reached the present day, is a singular production, entitled, "The Deipnosophists," or "Banquet of Philosophers," in which the author has contrived to exhibit a full view of ancient learning and opinions on all subjects. Larensius, a learned Roman citizen, distinguished by his great wealth and excellent taste, is introduced entertaining, at a splendid feast, the celebrated philosophers, professional and literary characters of his time. The various dishes furnish the topics of the miscellaneous conversation, which is conducted in the form of dialogue. Timocrates, one of the guests, makes remarks, and puts numerous questions; and the author himself, who is represented as being present at the entertainment, never fails in his replies to enter into a full discussion of the subject, and in this way displays the wonderful extent of his learning, by descanting on the opinions, the manners, and the domestic arts of the ancients. An edition of this curious work, with a Latin translation, was published in 1597, by the profound critical scholar Casaubon, and as late as 1801 a new edition appeared at Strasburg.

ATHENAGORAS, a Greek philosopher, who flourished about the middle of the 2d century, was greatly distinguished by his learning, and having been converted to Christianity, became a zealous and powerful defender of its doctrines. From Athens, where he had spent the early part of his life, and had acquired considerable reputation for his talents and eloquence, he removed to Alexandria, at that time the most celebrated seminary of learning in the east. At first a keen opponent of the Christian revelation, he carefully examined the arguments and evidence by which it is supported, and being convinced of the truth of its divine origin, openly avowed his belief, and displayed the same ardour and ability in the cause which he had espoused, as in his exertions to resist and subvert the gospel of Christ. The *Remonstrance*, or, as it is sometimes entitled, *Apology*, which he addressed to the Roman emperors, Marcus Aurelius, Antoninus, and Lucius Commodus, against the sufferings and oppressions to which the Christian church was at that time subjected, affords ample testimony of the zeal and erudition which the author employs in its behalf.

ATHENS, the most celebrated city of antiquity, and the capital of Attica, one of the states of Greece, during the long period of its prosperity, shone conspicuous in learning, arts, and political importance, and still exhibits, in its mouldering remains, abundant proofs of its former magnificence.

Like other cities and empires of which no records have existed, or have been preserved, the early history of Athens is involved in obscurity and fable. Ogyges, from whom Attica derived the name of Ogygia, and in whose reign Athens was devoted to Minerva, and was distinguished by her name, was the first king. After a period of several hundred years, Amphictyon held the sovereignty, and instituted the famous assembly of the states of Greece called the *Amphictyonic* Council. The illustrious deeds of Theseus raised him to the first rank of heroes, and the gratitude of his countrymen assigned him a place among the demigods. His immediate successors took an active part in the famous Trojan war; and Codrus, the last king, nobly devoted his life to his country, which, by a decree of the Oracle, could not be delivered from a threatened invasion but by such a sacrifice.

The abolition of royalty, which took place about one thousand years before the Christian era, and had continued for nearly the same period, was succeeded by the institution of archons, a more popular form of government, to whom the direction of the civil and religious affairs of the community was entrusted. The nature, distribution, and extent of the duties of those magistrates, have been detailed under Archon. The election of the archons was at first annual; it was gradually extended to a longer period, and seemed at last destined to become perpetual in the same family. In the struggles for power, on the one hand, and for liberty, on the other, Athens, throughout a long period of her history, was the constant scene of tumult and faction. To repress the prevailing disorders, and to resist the torrent of crimes which threatened to overwhelm the state, the power of framing a code of laws was committed successively to Draco and Solon, names that occupy a prominent place in the records of Greece, famed as they have been, the first for the undue severity, the last for the prudence and wisdom of his enactments. Solon flourished about five hundred years before the Christian era.

When Athens, by the wisdom of her legislators, the patriotism of her citizens, and the bravery and skill of her military commanders, had risen to high political consideration, both at home and abroad, she maintained for many centuries a protracted warfare with the other states of Greece, or with the overwhelming force of the Persians; and, in those repeated contests, the glories of triumph were sometimes exchanged for the ruin and disgrace of defeat. In the rapid strides which were made towards universal dominion by Philip, and his victorious son and successor Alexander, she yielded with the rest of Greece to the sway of the Macedonian monarch. When the Roman power extended to the east, Athens was besieged and taken by Sylla; and under succeeding emperors, as caprice or accident dictated, experienced the liberality and indulgence, or suffered from the oppression and neglect of her foreign rulers. During the reign of Adrian, and some succeeding monarchs, she recovered a large share of her ancient prosperity; her institutions were restored, and some of her splendid edifices were completed or repaired. But the severe destiny which awaited Athens was reserved for the period of Alaric king of the Goths. In the general destruction which marked his progress, the splendour of this renowned city was obscured for ever; her magnificent buildings were converted into a heap of ruins, and for seven centuries the name even was scarcely heard of. Having frequently changed masters, Athens fell at last, in 1455, under the dominion of Mahomet II. The Venetians, in whose hands it had remained for a short time, made two unsuccessful attempts, the first in 1464, and the second in 1684, to recover it from the Turks; but it has since continued in uninterrupted possession of the Ottoman Porte.

In the flourishing periods of its history, Athens acquired unrivalled celebrity for its schools of philosophy, the magnificence of its public buildings, and the progress and perfection to which the fine arts were carried. Even the topographical descriptions of the modern traveller, whose details are confined to fragments and ruins, furnish ample evidence of its ancient splendour.

Athens is divided into an upper and lower city. The upper city, or Acropolis, originally called the *citadel*, included, in early times, the whole population. The situation is elevated, and the sides are precipitous. Thus formed by nature as a place of strength, it has been destined, even down to the present day, to the purposes of a fortress. The entrance to the Acropolis was anciently adorned with the Propylea, a splendid edifice of white marble. The Parthenon, a magnificent temple, dedicated to Minerva, which is esteemed one of the finest specimens of ancient architecture, and is remarkable for simplicity and grandeur of style, has been always regarded as the chief ornament of the Acropolis. Within the same limits is erected the Erectheum, a double temple, with a common portico, dedicated to Neptune and Minerva Polias, a view of which is exhibited on Plate 16. of this work, and the admirers of Grecian art will be gratified in seeing this beautiful example of the Ionic order imitated in the public buildings for the county, now (1816) erecting in the Lawnmarket of Edinburgh, from the elegant designs of Mr Elliot. The Choragic monument of Lysicrates, which stands at the east end of the citadel, is described at page 449, under ARCHITECTURE, and is figured on Plate 17. The same plate presents a view of the Temple of the Winds, a singular structure of the lower city. The examples now alluded to will enable the reader to form some notion of the ancient magnificence of this famous city. The flat country surrounding the Acropolis is also covered with the remains of ancient structures, among which are enumerated the temple of Jupiter Olympius, the temple of Theseus, the Pantheon, the Gymnasium of Ptolemy, &c. The ancient harbours of Athens were, Piræus, distant from the city about four miles, and communicating with it by long walls, part of which is still seen,—Munychia, not far from Piræus—and Phalerum, about the same distance from the city.

Modern Athens lies on the north-east and north of the citadel. The population, composed of Greeks and Turks, is estimated at eleven or twelve thousand. The streets, which do not seem at any period to have been uniform and well arranged, are quite irregular, and the houses, in general, are mean and straggling, while the public buildings present a motely groupe of Turkish mosques and baths, and Greek convents and churches. Athens is situated in N. Lat. 38° 5', and E. Long. 24°.

The splendid collection of Grecian remains made by Lord Elgin, during his residence as British ambassador at Constantinople, and purchased by the nation at the expence of L.30,000 Sterling, and now deposited in the British Museum for public inspection, affords to the artist or admirer of ancient sculpture and architecture every facility of studying and improving his taste on these pure models. For a topographical account of Athens, the reader may consult *Atheniensia*, by Wilkins, 8vo, 1816; Stuart's superb work on its *Ruins*; and for a more general detail of its eventful history, he may be referred to Chandler's *Travels in Greece*, and the *Histories* of Rollin, Mitford, and Gillies.

ATHERINA, a genus of fishes belonging to the order Abdominales. See ICHTHYOLOGY.

ATHERSTONE, or ATHERTONE, a village of Warwickshire, in England, containing about 2600 inhabitants, who are employed in the manufacture of hats, ribbands, and woollen stuffs; and at a fair held in this place, a great deal of cheese is sold.

ATHLETÆ, from a Greek word signifying *combatants*, were persons among the Greeks who were trained to perform in the public games, and, from the nature of the exercises in which they were engaged, were necessarily possessed of great strength and agility. Such were the persons who exhibited their feats in wrestling, boxing, running, &c. at the Olympic, Pythian, and other celebrated games of the ancient Greeks.

To render the Grecian youth hardy and vigorous, and to enable them to bear the fatigues and privations of war, athletic exercises were particular objects of domestic policy. A gymnasium was established in every town, and institutions were appointed at the public expence, for the purpose of exercising young men, and even children, in those games and sports which were thought conducive to a strong and active constitution. The games or exercises common in Greece, were, leaping, wrestling, throwing the dart, the disc or quoit, boxing, and the *pancratium*, or medley of every kind of struggle or active exertion between two combatants.

ATHLONE, a town on the banks of the Shannon, in Ireland, partly in Westmeath and partly in Roscommon counties, and having a commodious communication by a bridge of numerous arches, on which a monument is erected, commemorating the defeat and public execution of some rebellious subjects in the time of Queen Elisabeth. Athlone is 55 miles west from Dublin; and, with a favourable situation, it derives no advantages from trade or manufactures.

ATHOL, the northern district of Perthshire, in Scotland, is a mountainous tract, about 40 miles long;

and 30 broad. Blair-Castle, the residence of the Duke of Athol, and its surrounding gardens and plantations, form a singular contrast with the general aspect of this elevated pastoral region; and the rapid streams of the Tilt, the Gary, and other mountain torrents, afford a striking feature to its picturesque scenery. The pass of Killicrankie, a narrow defile in this district, is noted in history for a battle between the troops of King William and King James, in the end of the 17th century.

ATHOS, a mountain of Macedonia, celebrated in the history and poetry of antiquity, rears its lofty summit far above the elevated promontory on which it reposes, and which projects into the Ægean sea. In the latitude of 40° north, the top of mount Athos is often covered with snow, a certain proof of its great height, which, in the absence of accurate measurement, has been vaguely estimated by some at two miles, or more than 10,000 feet above the level of the sea, and by others has been reduced to little more than 3000 feet.

Mount Athos, now called the *holy mountain*, from numerous bodies of Greek monks, who occupy 24 monasteries erected in different regions, is chiefly to be regarded as a place of religious retirement; and, with the churches and hermitages connected with these institutions, and some fortifications, furnished with cannon and other means of defensive warfare, exhibits to the traveller a striking scene. The monks of Athos were in former times distinguished by their learning, and were once in possession of some curious Greek manuscripts; but they are now more remarkable for poverty than literature, for manual industry in the culture of a rugged soil, than advancement in classical or theological knowledge.

ATLANTIS, or ATLANTICA, a very large island, or rather continent, for it is said to be equal to both Asia and Africa, which is alluded to by Plato in his Timæus, and noticed by other ancient writers, and whose situation is fixed beyond the Pillars of Hercules, the straits of Gades or Gibraltar. The account of such an island is regarded by some as altogether fabulous, while others suppose that the Canary islands, the Azores or Western islands, or even the American continent, is referred to and distinctly indicated in the descriptions of ancient writers; and Rudbeck, a Swedish author, maintains that Sweden and Norway are to be considered the Atlantis of antiquity. Other naturalists hold the opinion, that the Canary Islands and the Azores are merely the remains of the vast continent to which Plato assigned the name of Atlantis; and Mr Whitehurst alleges, that the Atlantis extended from the north of Ireland to the continent of America, and that the Azores islands form the only connecting link which has not been swallowed up by the effects of a convulsion, indications of which are strongly marked at the Giant's Causeway, and the northern coast of Ireland.

ATLAS, a chain of mountains in the north-western regions of Africa, and extending from the shores of the Mediterranean to Lower Susè. To the eastward of Morocco, the elevation is so considerable that they are seen at the distance of 140 miles, and they are covered with perpetual snow. Every variety of climate, from the stern severity of a polar winter to the powerful influence of a summer's sun in tropical regions, prevails in the Atlas mountains; and diversity of elevation exhibits dreary sterility or the rich verdure of luxuriant vegetation. Little is known of the mineral productions of this mountainous range. Granite, and marble of an excellent quality, are spoken of, from which it appears that they are partly at least composed of primitive rocks; and some of the metallic ores have been discovered. That part of the Atlas mountains which lies to the north of Morocco is chiefly inhabited by a robust people called Berebbers, who live in tents, and speak a language peculiar to themselves, and different from the Arabic. The labours of husbandry, and especially the rearing of bees for the honey and wax, are their principal occupations; but that part of the range which stretches southward from Morocco, is occupied by tribes called Shelluhs, engaged in similar pursuits, but different in language, manners, and dress from their northern neighbours, and living in towns and villages.

ATMOSPHERE, from the Greek, and signifying *sphere*, or *circle of vapour*, is the invisible elastic fluid which surrounds the earth, which is necessary for the respiration of animals, the growth of vegetables, and is not less essential to numerous processes of nature and art, which are constantly in a state of activity on the surface of the globe. The constituent parts of the atmosphere, which, by the most accurate experiments, are determined to be 79 of azotic gas, and 21 of oxygen gas;—the aqueous vapour, in an invisible form, which is converted into clouds, or falls in the state of rain, snow, or hail,—its weight or pressure, as it is indicated by the barometer,—its temperature, as it is ascertained by the thermometer,—its height, which is known by optical observations,—and the currents, or winds, to which it is subject, include the chief points of its chemical and natural history. See METEOROLOGY.

ATOM, the minutest particle of matter, beyond which, as the word, derived from the Greek, imports, it is unsusceptible of farther division. The doctrine of atoms, distinguished by the name of *atomical philosophy*, was a favourite subject of speculation with some of the ancient philosophers. First proposed by Moschus, a Phœnician, who lived before the period of the Trojan war, the doctrines of the atomical philosophy were enlarged and extended by Epicurus, and from his name were denominated the *Epicurean philosophy*.

According to the original doctrines on this subject, all the bodies in nature are composed of atoms which are indivisible, impenetrable, and eternal; and the diversity of constitution in natural objects arises from the diversity of arrangement and combination of the same minute particles. But in the Epicurean philosophy the atoms are not only the elements which enter into the composition of all material bodies, but they are endowed with a principle of motion to which are ascribed all the operations of nature; and thus the agency of an intelligent First Cause is excluded from this speculative system.

The atomical theory has been revived of late years by chemical philosophers, in the opinion of some with doubtful advantage, while others maintain that it must prove of the most essential benefit to the science of chemistry. The premature adoption of the doctrine of definite proportions, which was first hinted at by Mr Higgins, and was pursued and extended by Mr Dalton and others, may tend, as it appears to some, to retard rather than to promote accurate investigation, by accomodating the results of analysis to the deductions of theory. But, on the other hand, the establishment of this doctrine fixes chemistry on a sure basis; and it can scarcely be doubted, that a compound exhibiting invariably the same character and properties consists of the same constituent parts, and in the same proportions; but whether even the refined experiments of modern chemistry afford the means of determining with precision those proportions, can perhaps only be known in the future progress of the science.

ATOOI, or Attowa, a large island, belonging to the cluster called Sandwich islands, in the Pacific ocean. See Sandwich Islands.

ATRACTYLIS, Distaff Thistle, a genus of plants belonging to the Syngenesia class.

ATRAGENE, a genus of plants belonging to the class Polyandria.

ATRAPHAXES, a genus of plants belonging to the Hexandria class.

ATREBATES, or Atrebatii, a people of Gaul mentioned by Cæsar as forming part of the Belgic confederacy against him; and from the proportion of troops, stated at 15,000, which they furnished, it would appear that they were distinguished by their power and numbers. When they were forced to submit to the Roman authority, Comius, one of their chief men, ruled over them as the deputy of Cæsar. Arras in Artois, was the seat of the capital of the Atrebates in France.

A people of the same name, supposed to have been a Belgic colony which had settled in Britain before the invasion of Julius Cæsar, occupied part of Berkshire and Oxfordshire in England.

ATREUS, a king of Mycenae in ancient Greece, and the father of Agamemnon and Menelaus, who were very distinguished personages in the history of the Trojan war. Atreus is supposed to have reigned in the 13th century before the Christian era.

ATRIENSES were household servants of the ancient Romans, who are occasionally alluded to by classical writers. They were so denominated from having the superintendance of the *atrium*, or court belonging to the houses of great men, and in particular they were entrusted with the care of the statues and images of the ancestors of their masters, which were arranged round the court, and which, among that people, were objects of great veneration. It was one part of the duty of the Atrienses to carry these images at funeral processions. But it would appear that all domestic concerns came under their charge, and sometimes they were employed as agents or procurators.

ATRIPLEX, Orach, or Sea-Purslane, a genus of plants belonging to the class Polygamia, and of which several species are natives of Britain; one species, *hortensis*, is a common weed in gardens, and some are not unfrequent on sandy shores.

ATROPA, Deadly Nightshade, a genus of plants belonging to the Pentandria class, and of which one species, *Belladonna*, is a native of Britain, but fortunately, as it is a deadly poison, is a rare plant. The berries of a shining black colour, and about the size of a small cherry, are half inclosed within the permanent cup of the flower. The whole plant has a lurid aspect, and, from its general habit, is arranged under the natural order which derives its character from that appearance, and is appropriately called Luridæ.

ATROPHY, derived from the Greek, and signifying *without nourishment*, is a term applied to those diseases in which the body, from deficient nourishment, slowly and gradually wastes away without any violent symptoms. Such is the case in certain diseases of the digestive organs, and particularly in affections of the *mesenteric* glands, in which the progress of the nutriment is retarded or altogether interrupted.

ATROPOS, one of the *Parcæ*, or Fates, according to ancient mythological history, whose office it was to cut the thread of life.

ATTACHMENT, a term in English law, which is applied to a writ or precept issued by order of a court for the apprehension of a man's person, or for the seizure of his goods; and in this, arrest, which extends only to restraint on the person, is different from attachment.

Attachment also signifies a precept of the superior courts for apprehending those who refuse to obey their orders or decrees. See Blackstone's *Commentaries*.

ATTAINDER, a term in law, is the immediate consequence of the sentence of death, which being pronounced, as it is the highest judgment known to the laws of England, the criminal who is the object of it is placed out of the protection of the law, is marked with infamy, and is therefore said to be attainted, that is *stained* or blackened. Attainder only can take place after judgment is pronounced; for even after conviction some plea may be offered in arrest of judgment, by which the effects of attainder are obviated. Attainder becomes effectual by process, by appearance, or by act of parliament; by process, when the criminal escapes and is declared an outlaw; by appearance, in consequence of confession or verdict; and by act of parliament, as in the case of the persons who were guilty of the murder of Charles I. and in others since that period.

Forfeiture of goods and corruption of blood are the consequences of attainder. Blackstone's *Commentaries*.

ATTAINT, is a term in the law of England, and signifies a writ which lies to inquire, whether the verdict pronounced by a jury of twelve men be not false, that the consequent judgment may be reversed. But this mode of proceeding is superseded by a new trial. Blackstone's *Commentaries*.

ATTELABUS, a genus of insects belonging to the order Coleoptera.

ATTENTION is a steady application of the mind to the objects of perception and reflection, for the purpose of obtaining precise information concerning their properties and relations. The word, in its original meaning, signifying *stretching towards*, is strongly and metaphorically expressive of this effort of the mind in contemplating the objects of its consideration. Attention operates in various degrees in different minds and on different occasions. One seems capable of bending his whole mind, for any length of time, to a single object; while another cannot for a moment fix his attention on the same individual objects of perception or thought; and a remarkable occurrence draws forth a strong effort of attention, and makes a deep impression on the mind, but an ordinary incident passes unnoticed, and is soon forgotten.

Various questions have been agitated concerning attention, with regard to its nature and mode of operation; as whether it should be considered as a distinct power of the mind, or merely the exercise or application of its other faculties; and whether the mind, when occupied with the objects of perception or thought, can direct its attention to more than one object at the same instant. Some philosophers who seem not to have fully appreciated the rapid and insensible transitions of the mind in its operations, are disposed to reply to the latter question in the affirmative, and to adopt the opinion that more than one object can be brought under the same mental operation and at the same instant, provided the whole picture of the object be painted on the retina: But it is alleged by others, and with more probability, that attention even to the minutest objects, and to the consideration of their properties and relations, really includes a series of operations which succeed each other with such rapidity that they seem to be only a single instantaneous effort.

ATTENUANTS, or Attenuating Medicines, is a term which is now rather antiquated, and, as the word signifies, is applied to such substances as were supposed to have the effect of diminishing the excessive consistence of the blood and other fluids of the body, which had been produced by disease.

ATTERBURY, Francis, an English divine, who by a rapid career of promotion attained to the see of Rochester, was the son of Dr Lewis Atterbury, rector of Milton in Buckinghamshire. His birth is dated in 1662. At a proper age he became a scholar at Westminster school, was, in 1680, elected a student of Christ's Church college, Oxford, he was admitted, in 1687, to the degree of M. A., and during his residence at college was equally conspicuous for his mental capacity and for his literary acquirements.

The period of his entrance into holy orders has not been recorded; but in 1693 he made an unsuccessful application to be appointed his father's successor; and to spend his days as the rector of his native parish, had hitherto been the ultimate object of his ambition. Disappointed of his object, and disgusted with the dull routine of college duties (which in one of his letters he calls 'the nauseous circle of small affairs,' whence he could derive neither amusement nor instruction,) he resolved to enter on a more active scene of life, and forthwith went to London. He rose rapidly to honour, and to eminence. Chaplain in ordinary to King William and Queen Mary, preacher at Bridewell, lecturer at St Bride's, archdeacon of Totness, doctor of divinity, chaplain in ordinary to Queen Anne, dean of Carlisle, prolocutor of the lower house of Convocation, and dean of Christ's Church, are among the number of the preferments which crowded upon him in rapid succession. And, to crown the whole, on the recommendation of the earl of Oxford, he was, in 1713, advanced to the see of Rochester, and the deanery of Westminster. A man of lofty views, he was not content with the honour, or the influence which this distinguished station conferred, but looked upward with desire to the still higher dignities of the church, and aspired, it is said, to the primateship of all England; and so prudently had he taken his measures, that had a vacancy occurred during the life of the Queen it is probable he would have been archbishop of Canterbury.

But on the accession of George I. to the throne of Great Britain, Atterbury's sun of prosperity began to darken. He had offered the King, on his coronation, the chair of state and royal canopy, perquisites of the deanery of Westminster, which were rejected with evident tokens of dislike to his person. From that time the bishop of Rochester opposed all the measures of the court. He refused to sign the declarations of the bishops against the claims of the house of Stuart; and so strong was the suspicion of his having a share in a plot in favour of the Pretender, that, in 1722, he was apprehended and committed to the tower. In the following year a bill was brought into the House of Commons, which passed into a law, by which he was doomed to perpetual exile. In June 1723 he embarked for France, where, in 1731, he died, as it is supposed of a broken heart, occasioned partly by his degradation and banishment, but chiefly by the death of his daughter. His body was brought to England, and interred in Westminster abbey.

As an author, Atterbury sustained the character of a poet, of a polemic, and of a preacher. His poetical talent was displayed at any early age in a Latin translation of Dryden's Absalom and Ahitophel, in a translation of some of the Odes of Horace, and in an elegant Epigram on the Fan of the Lady whom he afterwards married.

But he soon neglected the muses to court the stern genius of controversy. His first essay, in this department, was in defence of the Reformation, and in vindication of the character of Luther, its illustrious champion. The severest contest which he sustained was with Dr Wake, respecting the rights, powers, and privileges of the clergy. Dr Wake, who was afterwards archbishop of Canterbury, had endeavoured to prove, that the right of convening the clergy was vested in the prince;—that they can discuss nothing without his permission;—that his power over their constitution and decrees was supreme;—and that he alone can dissolve their synods. In opposition to these positions, Atterbury maintained, that the clergy have a right to meet and deliberate independently of any superior power; and treats his antagonist's book 'as a shallow empty performance, written without any knowledge of our constitution, or skill in the particular subject of debate.' In consequence of the zeal which he displayed in this curious controversy, he was viewed by the one party as a man of a hot and acrimonious mind, and treated with a large portion of abuse; while, by the other side, he was regarded as an able advocate of high church principles, and received the thanks of the lower house of Convocation, and the degree of doctor in divinity from the university of Oxford. Besides these disputes, some of the doctrines which he had taught in his sermons, particularly that of passive obedience, were called in question by Mr Hoadly, which engaged him in a controversy with that divine. A view of these disputes, with copious extracts, will be found in the Biographia Britannica.

As his eloquent sermons, and impressive manner of preaching, first brought the bishop of Rochester into notice, so his character as an author must be estimated from his compositions of this description, which have been long before the public, and which are still read as specimens of genuine pulpit eloquence. His sermons, contained in four octavo volumes, embrace a variety of topics, which are treated with great clearness, simplicity, and warmth of expression. He speaks both to the understanding and the heart of his hearers; and as he possessed a keen and ardent mind, and an animated countenance, he must have been heard with attention. Let the violence of this great man's temper, which the heat of controversy provoked; let the party zeal which he displayed, and which some think is rendered excuseable by the turbulence of the times, be buried in oblivion, and let us learn diligence from his example, and piety and virtue from his works.

ATTICA, a peninsular region of ancient Greece, having Peloponnesus for its boundary on the west, the Ægean sea and the Saronic gulf for its limits on other two sides, and united by land with Bœotia; derived more of its celebrity from Athens, the capital, than from the whole state; and, indeed, the ancient splendour of the latter seems to have sunk the former into comparative obscurity. Eleusis, Sunium, and Marathon are its other chief towns, some of which are connected with the most celebrated exploits recorded in Grecian history. Attica is described as a barren district. Among its vegetable productions the olive has been famous from the earliest times to the present day; and the abundance and excellence of the honey of Mount Hymettus have been well known in all ages. See GREECE.

ATTILA, the celebrated king of the Huns, who assumed the reigns of government in 433, was remarkable for the deformity and strength of his body, and the boldness and fierceness of his look, for his military prowess, and the immense armies, amounting to 500,000, or, according to some accounts, to 700,000 barbarians, which obeyed his command, and the vast extent of empire, stretching from the borders of China to the banks of the Danube, over which he swayed the sceptre of uncontrouled authority. The cruelty and barbarity which accompanied his numerous and extensive conquests, imposed upon him the reproachful designation of the *Scourge of God*. From a peculiar habit which he had acquired of fiercely rolling his eyes, it is supposed that he wished to inspire terror in those who were near his person. 'The crowd of the vulgar kings, (says Gibbon,) the leaders of so many martial tribes, who served under the standard of Attila, were ranged in the submissive order of guards and domestics around him. They watched his nod, trembled at his frown, and at the first signal of his will executed, without murmur or hesitation, his stern and absolute commands."

His death, which happened about the year 453, was attended with singular circumstances. He had married a new wife, a beautiful virgin; the nuptials were celebrated with great pomp and festivity, at his palace beyond the Danube, and he retired late to bed oppressed with wine. A blood-vessel in the lungs burst in the night, and produced suffocation. In the morning the bride was found sitting by the bed-side, overwhelmed with tears and lamentations at the sudden event, and the danger which probably awaited her. "The body of Attila was exposed in the plain, while the Huns, singing funeral songs to his praise, marched round it in martial order. Enclosed in three coffins of gold, silver, and iron, it was privately interred during the night; and to prevent the violation of his remains by the discovery of the place where he was buried, all the captive slaves who were employed in the solemnity were barbarously massacred." Gibbon's *Roman History*.

ATTORNEY, a person who transacts any business in place of another, either in a public or private capacity. In the latter case he is appointed by *letter of attorney*, and in the former he manages the law proceedings of his client by warrant or authority from him; and in this character he is denominated *Attorney-at-Law*.

Attornies-at-law must be formally admitted and sworn into the particular courts in which they practise. A practitioner in the court of King's Bench cannot appear in the court of Common Pleas; an attorney in the latter cannot act in the former; and to practise in the court of Chancery he must be regularly admitted a solicitor in that court. Attornies are regarded as members of their own courts, are subject to the regulation and animadversion of the judges, and, at the same time, enjoy many valuable privileges. Without being admitted in a superior court of record, no person can act as an attorney at the court of Quarter-Sessions. Blackstone's *Commentaries*.

ATTORNEY-GENERAL is the great law-officer of the crown in England, and is appointed to his office by the king's letters patent. It is the duty of the attorney-general to exhibit informations, and to prosecute for the crown in criminal matters, and to file bills in the Exchequer for any thing concerning the king in inheritance or profits.

ATTRACTION, is a general term in natural philosophy to denote that power by which all bodies tend to each other. This power or property pervades all nature. It operates on the minutest particles, as well as on the largest masses of matter, and under various modifications has received different names. When it acts at sensible distances, as when the planets of the solar system are drawn towards the sun, or when a stone unsupported falls to the ground, it is distinguished by the general name of the *attraction of gravitation*. When two polished surfaces of glass, marble, or metal, are brought into close contact by the exclusion of the air, they are strongly drawn towards each other, and this modification of attraction is called *adhesion*. When particles of matter of the same kind are united, the power which operates is denominated the *attraction of aggregation*, or *cohesion*. But when the minute particles of matter of different kinds enter into combination, as oil of vitriol, or sulphuric acid and soda, a new compound, totally different in its character from its constituent elements, or the familiar substance, Glauber's salt, is obtained; and this constitutes the true character of chemical attraction or affinity, where the particles of matter act on each other at insensible distances. See *Affinity*, under CHEMISTRY, and *Universal Gravitation*, under ASTRONOMY.

ATTRIBUTE, in its general meaning, is a quality or property essential to the nature of a person or thing. Understanding is said to be an attribute of mind, and extension is an attribute of matter.

ATTRIBUTES of God, are those perfections which belong to the character of the Supreme Being, as his infinite power, wisdom, justice, and goodness.

ATWOOD, GEORGE, an English mathematician and natural philosopher of considerable eminence, was born about the year 1745, was educated at Westminster school, and prosecuted his studies at Cambridge with so much success that he became a fellow of Trinity college, and afterwards one of the tutors. He delivered lectures on experimental philosophy at Cambridge for several years, which were numerously attended and greatly admired; and having given up his residence at the university, he was much employed in financial calculations by the late Mr Pitt, who appointed him to a sinecure office for the purpose of retaining his services in that department of his political arrangements. Mr Atwood died in London in 1807, when he had reached the 62d year of his age.

The scientific labours of Mr Atwood were chiefly employed on physical subjects; and his investigations on *Rectilinear Motion and Rotation of Bodies*, on *the Stability of Ships and Floating Bodies*, on *the Construction of Arches*, &c. with an *Analysis of a Course of Lectures*, and a Description of Experiments for their illustration, and a Review of the Regulations for the *Assize of Bread*, were published in detached treatises, or in memoirs in the Philosophical Transactions. He was also the inventor of an ingenious apparatus for illustrating experimentally the doctrine of accelerated and retarded motion, or determining the quantity of matter, the moving force, the space described, the time of description, and the velocity acquired by a falling body.

AVA, an extensive kingdom of Asia, in the peninsula beyond the Ganges, having Tonquin and Cochin-China on the east, and China and Thibet on the north, is well watered by numerous streams, and abounds in vegetable productions. The territory of Ava is now included in the Birman empire. See BIRMAH.

AVA, the capital of the kingdom of Ava, was formerly a flourishing city, but is now falling to decay since the seat of government has been removed to Ummerapoora, which is the present capital of the Birman empire. Ava, which stands on the banks of the river Irrawaddy, was once four miles in circumference, and was defended by a wall and ditch; but its roofless houses, ruined temples, and deserted streets, present a melancholy contrast with its former prosperity.

AVALANCHES are huge masses of snow, which are detached from the base on which they rest in Alpine regions, and chiefly in the Alps of Switzerland, partly by the melting of the snow, and the water thus generated being conveyed through fissures, producing a separation between the side of the mountain and the inferior stratum of snow, and partly, it seems probable, by the heat of the earth dissolving the lower stratum, and are precipitated, by their incumbent weight, into the vallies below, overwhelming forests, fields, and villages. Some of these masses of frozen snow, 200 feet in diameter, have been observed.

AUBAINE, or *droit d'Aubaine*, was a right claimed by the kings of France to the inheritance of foreigners who died within their territory. The Swiss, Savoyards, Portuguese, and Scots, who were considered natives of France, and ambassadors from foreign states, were exempted.

AUBE, a department of France, which is thus denominated from a river of the same name by which it is traversed, is bounded on the north by the department of the Marne, and on the west by that of the Seine and Marne; part is covered with forests, part of it is abundantly fertile in grain and fruits, and part is remarkable for its sterility. The population exceeds 240,000, and Troyes is the capital.

AUBLETIA, a genus of plants which belongs to the Polyandria class, and derives its name from M. Aublet, a learned French naturalist, who is the author of an elaborate work on the plants of Guiana.

AUCH, the capital of the department of Gers in France, and formerly the chief town of Gascony, stands on a declivity near the river Gers, is about 400 miles south-west from Paris, and contains nearly 8000 inhabitants. The streets are narrow, but clean and well paved, and some of the modern buildings are not without elegance. The archbishop's palace is a princely structure; and the cathedral, which is remarkable for the rich profusion of its internal decorations, is described as one of the most magnificent edifices in France.

AUCKLAND, or BISHOPS AUCKLAND, a borough town of the county of Durham in England, derives its first name from the forest of oaks formerly in its vicinity, and the additional appellation from the palace, which is the residence of the bishops of Durham; stands on an elevated spot near the confluence of the Wear and Wandless, and contains nearly 2000 inhabitants, part of whom is employed in manufactures, especially in the printing of calico and other cotton stuffs.

AUDE, a department of France, having the Pyrenees on the south, and the sea on the east, and traversed by a river of the same name, has a tolerably fertile soil, and some extensive forests, is famous for its honey, contains a population exceeding 226,000, and Carcassone is the capital.

AUDRAN, CLAUDE, a French engraver, who was born at Paris in 1592, and having attained the venerable age of 85, died at Lyons in 1677, was less distinguished as an artist than as being the first of a long race of the same name in the same profession, and as being the father of three sons, some of whom rose to great eminence. The brother, or, according to some accounts, the cousin of Claude Audran, was also a respectable engraver; and his prints of the *Annunciation* from Hannibal Carracci, and the *Assumption* from Domenichino, are still regarded as excellent productions.

AUDRAN, Gerard, the third son of Claude Audran, was born at Lyons in 1640, and died at Paris in 1703. He was by far the most celebrated artist of this remarkable family, and executed some highly prized engravings from pictures by the first masters. But the powers of his art shine conspicuous in the *Battles of Alexander*, which are universally admired as wonderful productions of the graver, and in which it has been strongly expressed, that he surpassed even the expectations of the painter himself. The prints alluded to are *the passage of the Granicus; the battle of Arbela;* and *Porus brought to Alexander, after his defeat*,—all of large size, from pictures by Le Brun: To this series were added two others, from pictures by the same artist; namely, *Alexander entering the tent of Darius*, which was engraved by Gerard Edelink, and *the triumphal entry of Alexander into Babylon*, executed by Audran. It may be worth while that the admirer of these splendid engravings should recollect that the impressions in highest estimation are marked with the name of Goyton the printer.

AVEBURY, or Abury, a village of Wiltshire in England, is about nineteen miles north from Stonehenge, and is famous for its druidical temple, the scanty remains of which still exhibit a singular monument of British antiquity. Surrounded by a ditch and rampart, this sacred structure was composed of several concentric circles, with a central obelisk, and two avenues, one of which led to the south-east and the other to the west; the whole consisting of single stones placed perpendicularly in the ground, and rising from ten to nineteen feet above the surface. The avenues, formed of 200 upright stones were a mile long; and the structure, when entire is supposed to have been composed of not fewer than 650 stones. See Britton's *Beauties of Wiltshire*, Vol. III.

AVEIRO, or New Braganza, a sea-port town in the province of Beira in Portugal, stands in a flat marshy country, and contains nearly 5000 inhabitants. The river Vouga traverses the town, but the shallowness of the water admits only vessels of small size. The trade is inconsiderable, but the fishery, which supplies the province with sardinhos, is a copious source of employment and profit to a large portion of the population, and the manufacture of salt in the vicinity is extensive.

AVELLINO, a town of Naples, is situated on the declivity of a hill, and contains about 9000 inhabitants, who are chiefly employed in the manufacture of woollen cloth, wooden chairs, maccaroni, and pastes of different kinds, the latter of which are in great esteem throughout the surrounding country. The soil of the district, which is chiefly of a volcanic nature, is unfavourable to the production of corn; but fruits are abundant, and the cultivation of the Spanish filbert is so successfully conducted, that the amount of produce, in a good season, exceeds 11,000l. Sterling. The trees are planted in regular rows, and are carefully trained and dressed.

AVENA, Oats, a genus of plants belonging to the class Triandria, and including the cultivated oat with its numerous varieties, the wild oat, and some other species, which are natives of Britain.

AVENCHE, an ancient town in the canton of Berne in Switzerland, stands at the southern extremity of the lake Morat, and is now chiefly remarkable for the splendid remains of its former magnificence, which are scattered in great profusion within a circuit of five miles; among which are enumerated fragments of an amphitheatre, the floor of a bath, executed in mosaic work, and adorned with human figures, cornices of white marble sculptured with urns, griffins, and sea-horses, and a stupendous column of white marble, sixty feet in height, all which afford certain evidence of this place having been a favourite residence of the ancient Romans. Coxe's *Travels in Switzerland*.

AVENZOAR, an Arabian physician, and one of the earliest writers on medicine, flourished about the end of the 11th century, was born in Spain, and belonged to a family, in which the profession seemed to be hereditary. He lived, it is said, to the great age of 135; and the splendour of his talents and acquirements, or the extravagance of fulsome adulation, called forth from his cotemporary, and supposed pupil, Averroes, the lofty titles of "*Admirable, glorious, the treasure of all knowledge, and the most supreme in physic.*"

AVERNUS, a famous lake, not far distant from Puzzuoli in Campania in Italy, the exhalations of which were supposed to have been of so pestilential a nature that no animal could approach it with safety; and even birds flying across its surface were suffocated by its vapours and dropped down dead. The more accurate observations of modern naturalists have completely subverted the erroneous information concerning this lake and others to which similar effects were ascribed, and which were drawn from the groundless details of mythology, or the fancied descriptions of poetry. Lake Avernus in Italy was supposed to be bottomless, two miles long, and about a mile broad. The depth is ascertained to be less than 200 feet; and it presents a fine expanse of limpid water abounding with fish. A gloomy cave on its banks is described by Virgil as the residence of the Cumean Sybil.

AVERROES, an Arabian philosopher, was born about the beginning of the 12th century at Cordova, in Spain, then the capital of the Moorish territory in that country, was educated in the university of Morocco, and became so eminent in mathematics, law, medicine, and divinity, that he was regarded as one of the first philosophers of the age. He was particularly celebrated by his elaborate annotations on the works of Aristotle, and was long known in the schools by the distinctive appellation of the Commentator; and was not less notorious for his indiscriminate rejection of every religious creed, Jewish, Christian, and Mahometan.

AVEYRON, a department of France, watered by a river of the same name, has the department of Tarn on the south, and that of Cantal on the north. The surface and soil are more suited for pasture, and the rearing of numerous herds of cattle, than for the culture of grain. Hemp is extensively cultivated, and the vine grows luxuriantly. Coal, alum, and the ores of iron, lead, and copper, are enumerated among the mineral productions. The population exceeds 326,000, and Rhodes is the capital.

AUGITE, a crystallized mineral, belonging to the siliceous genus, and a native of basaltic rocks. See MINERALOGY.

AUGSBURG, the *Augusta Vindelicorum* of the Romans, a city in Swabia in Germany, stands in a fertile and beautiful plain near the confluence of the rivers Lech and Werlach, and is 300 miles west from Vienna, and 40 miles north-west from Munich. The trade of this city was in former times most prosperous, and some of its merchants were the wealthiest citizens in the empire; but it has now greatly declined. The population is estimated at more than 30,000, who are occupied in various kinds of manufactures, as those of cotton stuffs, leather, paper, dyeing, bleaching, gold and silver lace, clocks and watches, and toys. Literary labour, once respectable in Augsburg, is now confined to the production of religious tracts for children and the common people, picture books of a similar description, and cheap maps. Two-thirds of the inhabitants are Roman catholics, and the rest are Protestants; and it is only since the commencement of the present century that Jews were permitted to reside within its walls.

The streets are regular and spacious; the houses are constructed partly of wood and partly of freestone; and some of the churches, and other public buildings, can boast of great elegance, and a profusion of rich ornaments. The town-house is a magnificent edifice, adorned with a splendid marble portico, and numerous brazen figures of animals richly gilt; and the public fountains are equally ornamental and beneficial to the city. The fountain of Augustus is a fanciful structure, composed of figures of brass in the form of men, women, children, dolphins, and sphinxes, and from the centre rises a pedestal surmounted by a statue of Augustus of the size of life. Augustus Cæsar is regarded as the founder of the city, and from him it derives its name. An aqueduct conveys the waters of the Lech to the city for the supply of the fountains, and for communicating motion to the machinery of various manufactories.

Augsburg suffered greatly during the French revolutionary war, from the various fortunes of the contending powers, and was at last attached to the kingdom of Bavaria.

Augsburg Confession.—But this city holds a most conspicuous place in history, in consequence of the famous diet which met in it, and at which the Lutheran confession of faith, hence called the Augsburg *Confession*, was presented to the emperor Charles V. This diet assembled in 1530; and the confederate princes who espoused the cause of reformation, and had protested against the decree of the imperial diet of Spires, passed a few months before, first assumed the distinctive appellation of *Protestants*. This celebrated confession, which was drawn up by Melancthon, the coadjutor of Luther, consists of 20 chapters, containing a detailed view of the religious creed of the reformers, and the reasons of their separation

from the church of Rome. It was read in the public hall, in presence of the Catholic and Protestant divines; and although some modifications were made on objectionable clauses, and the influence of the emperor was interposed, yet the conference produced no reconciliation. Some of the Protestants themselves disapproved of parts of the confession, separated from the Lutherans, and assumed the name of *Evangelical Reformed*, by which denomination a large proportion of the German Protestants is at this day distinguished. See Robertson's *History of Charles V.*

AUGURY, a kind of divination, or mode of fortelling the nature of future events, by observing the manner of feeding, the flight, and the chattering or singing of birds. It was practised by the ancients, and especially by the Romans, who rarely undertook any important affairs without previously consulting those who studied and superintended the system of augury, which ignorance and superstition had established among that people.

Augury was practised among the Romans in the earliest period of the state. Romulus appointed three augurs of patrician or noble rank. When the influence of the people had increased in the commonwealth, the college of augurs was enlarged to nine, four of whom were chosen from the Patricians, and five from the Plebeians. Six were afterwards added to the number; and the institution, now composed of fifteen members, continued to be held in high respect and dignity during the prosperous periods of Rome. The augurs were next in dignity to the order of priests; they were clothed in splendid robes of purple and scarlet; they wore a cap of a conical form; and while they exercised their mysterious functions they held the *lituus*, or divining rod, which was a crooked staff, in their hand.

The Roman augurs, aware of the imperfection of their system of divination when they trusted for the exercise of their art to the casual and uncertain motions of wild birds, not always within their observation, improved and refined upon it by keeping a number of chickens, to which the epithet of *sacred* was added, and from their motions and manner of feeding they could at all times predict the good or bad fortune of those who consulted them on future events.

Augury, although not formally practised in the present day, is not yet entirely eradicated from the human mind. The lights of science and religion, and the general diffusion of knowledge, have not been able to dispel the gloomy forebodings which are excited by the actions of some of the feathered tribes. The crowing of a cock at an unusual hour, is regarded by many as an ominous presage; and to the weak and superstitious, the croaking of the raven, in certain circumstances, and the screaming of the night-owl, are the awful harbingers of misfortune.

AUGUST, the eighth month of the year, according to the modern kalendar, was the *sextilis*, or sixth month of the Romans, reckoning from March, the commencement of their year, but was changed to his own name by Augustus Cæsar, because that month had been peculiarly favourable to his fortunes.

AUGUSTA, a town of Sicily, which stands on a peninsular spot on the eastern coast, and not far distant from the ruins of ancient Megara, was almost entirely destroyed in 1673 by an earthquake, has been since rebuilt with low houses, to obviate, in some degree, the dangers of similar accidents; contains about 15,000 inhabitants, and in former times served as a depot for the ships belonging to the knights of Malta to be supplied with stores and provisions.

AUGUSTINE, St. a learned bishop of the early Christian church, was a native of a small town in the interior of Numidia in Africa, and was born in the year 354, made rapid progress in his studies, and, while yet a youth, opened a school of grammar and rhetoric in his native place, and acquired great reputation by his public lectures on the same subject, which he delivered at Carthage, Rome, and Milan. Some doubts which he had entertained concerning the doctrines of Christianity were removed by hearing the eloquent sermons of St Ambrose, bishop of Milan, and from him he received baptism. Returning to Africa, and being ordained a presbyter, by Valerius, bishop of Hippo, he was afterwards associated with him in his episcopal functions. But before this period he and some friends had devoted themselves to retirement, fasting, and meditation, and having all things in common, subjected themselves to all the austerities and privations of the monastic life. St Augustine died in 430. His early life exhibited a scene of dissipation and licentiousness; but his maturer age was exemplary for virtuous conduct and the zealous discharge of all the duties of a Christian instructor. His works have been printed in ten volumes.

The ascetic life of St Augustine is the origin of the various orders of monastic institutions which have assumed his name. Soon after their regular establishment in the 13th century, the religious order of Augustine, or Austin friars, was introduced into England, and at the time of their suppression, in the 16th century, 32 establishments of the kind existed.

AUGUSTUS, the appellation conferred by the senate on Cæsar Octavianus, the first Roman emperor. The obscure name of *Octavianus* was derived from a family of no rank. "The illustrious name of Cæsar," Mr Gibbon observes, "he had assumed as the adopted son of the dictator; but he had too much good sense to hope to be confounded, or to wish to be compared with that extraordinary man. It was proposed in the senate to dignify their minister with a new appellation; and, after a very serious discussion, that of Augustus was chosen among several others, as being the most expressive of the character of peace and sanctity which he uniformly affected. *Augustus* was therefore a personal, *Cæsar* a family distinction." The first was the sacred title reserved for the monarch, the second was usually communicated to his relations, and, from the reign of Adrian, was appropriated to the second person in the state, who was regarded as the presumptive heir of the empire.

AVICENNA, pompously styled the prince of Arabian philosophers and physicians, flourished in the end of the 10th and beginning of the 11th century, in his earliest years had made great proficiency in grammar and the knowledge of the koran, and, as his intellectual powers were matured, became no less distinguished in mathematics and other branches of learning which were then the objects of pursuit and study. Like the philosophers of the age, Avicenna lived a wandering and unsettled life; now basking in the sunshine of prosperity at the courts of princes, now a houseless fugitive, exposed to all the rigours of adversity; now immersed in licentious pleasures, and now devoted to profound study. He died in the year 1036. The works of Avicenna on mathematics, metaphysics, morals, theology, natural history, and other subjects, are extremely voluminous; but the laborious undertaking of an Encyclopædia, or general view of human knowledge, which he dignified with the quaint and expressive title of the *Utility of Utilities*, and which, it is said, was projected in his 21st year, and soon executed in 20 volumes, is of itself a gigantic performance, and affords sufficient evidence of a vigorous mind and indefatigable industry. While scholastic philosophy and divinity were held in repute, the works of Avicenna were much read and greatly admired.

AVICENNIA, or Eastern Anacardium, a genus of plants belonging to the Didynamia class.

AVIGNON, the capital of the department of Vaucluse in France, stands on the eastern bank of the Rhone, is surrounded by battlements which include a circuit of three miles, and contains about 30,000 inhabitants. The streets have no claim to regularity or beauty; but the public edifices in their decaying grandeur still display striking marks of their former magnificence. Some of the churches are adorned with monuments which, in elegance of design and perfection of execution, have been rarely surpassed, and with paintings which have been always ranked among the finest productions of the pencil. The defaced tomb of Laura, the celebrated object of Petrarch's hopeless passion, and of her husband, in the church of the Cordeliers, is still visited by the curious stranger; and in a valley five miles from the city is the fountain of Vaucluse, of poetical celebrity, the retirement which Petrarch often sought to indulge his grief and misplaced affection. The pointed extremity of a projecting rock near the fountain, is surmounted by the remains of an ancient tower, which is still denominated the *castle of Petrarch*.

Avignon is conspicuous in history, as the residence of the papal see for a period of 70 years, from the time that Clement V. transferred it from Rome in 1309; and when the head of the Catholic church restored his court to the Vatican, a rival pope held a divided sovereignty in Avignon, till Martin V. succeeded in the year 1418, when it was erected into an archbishopric, and continued to be part of the ecclesiastical territory till the late revolution in France, when it was attached to the new republic.

AVILA, a city of Old Castile in Spain, stands in a spacious plain, surrounded with mountains, and covered with orchards and vineyards, is walled and fortified, contains about 2000 houses, many of which are well built, an university, numerous religious houses, and a magnificent cathedral; and some of the inhabitants are occupied in the cloth manufacture.

AUK, the name of a bird belonging to the order Anseres. See *Alca*, under Ornithology.

AUKLAND BISHOPS. See Auckland.

AULUS GELLIUS, a learned Roman, who flourished in the time of Adrian and the Antonines. He was a native of Rome, and as was the custom of the period in which he lived, he resided some time in Athens, for the purpose of prosecuting his studies at that celebrated school of philosophy. Having visited some of the other Grecian states, he returned to his native city, and rose to eminence in the profession of the law.

The *Noctes Atticae*, "Athenian Nights," the only production of Gellius known at the present day, was begun while he resided at Athens, and is a curious literary miscellany, containing various biographical, historical, and critical observations on ancient authors and passages of their works, and exhibiting an instructive picture of the manners, customs, and opinions of antiquity. Various editions of this work have appeared, but the English reader has an opportunity of perusing it, and appreciating its merits, in a translation by Mr Beloe, published in 1795.

AVOCADO PEAR, the trivial name of the *Laurus persica*, a rich fruit of the West Indies, which, from its nutritious qualities, and resemblance to marrow, has been called *vegetable marrow*.

AURANCHES, or AVRANCHES, an ancient town of lower Normandy, now the department of the Channel, in France, contains about 5000 inhabitants, and is chiefly remarkable for the extensive ruins of the castle, and the lofty station of the cathedral, part of which occupies the extreme verge of an overhanging precipice. The stone on which Henry II. of England knelt when he received absolution from the Pope's nuncio for the murder of Thomas a Becket, in 1172, is said to be still preserved at the cathedral, and is pointed out to strangers as a curious relic.

AURANTIUM, the specific name of the orange tree in the Linnæan classification of plants.

AURELIA, the name by which insects are distinguished in one of the stages of their transformation by older naturalists, and analogous to the more modern appellation *Chrysalis*. See ENTOMOLOGY.

AURELIAN, or AURELIANUS LUCIUS DOMITIUS, one of the most powerful and celebrated of the Roman emperors, rose from the humble station of the son of a peasant in Pannonia, and from the rank of a common soldier, in which capacity he entered the army, to the exalted dignity of head of the empire, not less by his personal courage than by his military skill and prudent conduct. Having passed through the various subordinate ranks, he obtained the chief command of the army under Claudian, and acquired such reputation and influence that, on the death of that emperor, the irresistible voice of the soldiers, who shared his glory and his conquests, nominated him his successor, and in the year 270 placed him on the throne. Every territory, even the most distant which the Roman power had reached, was a witness of his triumphs. In his rapid and unexampled progress, the Persians and Egyptians, the Goths and the Vandals, were discomfited; and Spain, Gaul, and Britain, yielded to the force of his arms. But his power was not raised on a solid foundation. The discontents and murmurs of the higher orders of the people, excited by his marked partiality to the Plebeian rank, which he could not conceal, broke out into open and dangerous insurrection, in the suppression of which he displayed the cruelty and barbarity which, it is said, were natural to his disposition. In the commencement of the year 275, while he conducted a powerful army against Persia, one of his secretaries, who dreaded the punishment of extortion, had the address to persuade the chief officers that they were all involved in a general proscription. Watching the first favourable opportunity, they attacked him on the march from Byzantium, and he fell covered with wounds. The fraud was discovered when too late; but the traitor was exposed to the fury of wild beasts, and the funeral obsequies of the emperor were celebrated with great pomp and magnificence. Gibbon's *Roman History*.

AURENG-ZEBE, the great Mogul, one of the most successful conquerors and celebrated sovereigns of the empire of Hindostan, was the third son of Shaw Jehan, whom he succeeded on the throne, and was born in 1618. Actuated by strong ambition, Aureng-zebe was one of those who

—— wade through slaughter to a throne.

Under the humble garb of a religious recluse, he acquired a high character for sanctity among his countrymen, while he was concerting measures for securing to himself the sovereignty. But before he reached the summit of his boundless wishes, three of his brothers were doomed to be the victims of barbarous assassination. He was proclaimed emperor in 1659, during his father's lifetime; and when he had obtained the undivided possession of the throne of Delhi, no rival appeared to disturb the profound tranquillity which reigned throughout the empire for the long period of twenty years. But his exertions to convert his Hindoo subjects to the Mahometan faith excited tumults and insurrections in various parts of his dominions, and kept him, during the latter years of his life, in constant disquiet and alarm. He had succeeded in the reduction of some of the insurgent states; but while he had retired to winter quarters at Ahmednagur, he was seized with an illness which proved fatal in 1707, and when he had reached the 90th year of his age. By his own directions, his body was deposited in the tomb of a holy dervise, without pomp or ornament. His memory is held in great veneration by the Mahometans; and his tomb is the frequent resort of pilgrims, for the purpose of performing their devotions. Dow's *History of Hindostan*.

AURIPIGMENTUM, signifying *pigment*, or *paint of gold*, or orpiment, is an old name for sulphuret of arsenic, a common ore of that metal. See MINERALOGY.

AURORA, the morning twilight, or the faint light which precedes sun-rising; and, in ancient mythology, the goddess of the morning, who is represented by the poets in a chariot rising from the ocean, with rosy fingers dropping dew. In Virgil's description of the goddess of the morning, she is drawn by four horses in a flame-coloured chariot.

AURORA BOREALIS, NORTHERN LIGHTS, or, according to the vulgar appellation, *Streamers*, or *Merry Dancers*, a luminous meteoric appearance, which is observed most frequently in frosty weather in northern regions of the atmosphere, and hence the origin of its first name, which is become less appropriate since the discovery and description of a similar appearance in high southern latitudes by Mr Forster, the naturalist who accompanied Captain Cook in his second voyage round the world. It is a curious fact in the history of this meteor, that, with the exception of some doubtful descriptions by Aristotle and Pliny which seem to refer to it, observations on the *aurora borealis* are limited comparatively to modern times. The first on record was observed in January 1560, and is mentioned under the descriptive appellation of burning spears. It was again seen in 1564 and 1574 in England, in 1575 in Brabant, and in 1580 and 1581 in some parts of Germany; in 1621 it was observed all over France; and in 1623 it was seen throughout the greater part of Germany; but from that time, during a period of eighty years, no record exists of any such appearance. It reappeared for a short time in Ireland in 1707, and was seen in the same and the succeeding year in Denmark. But the *aurora* which was observed in 1716, and is minutely described by Dr Halley, was remarkable for its brilliancy and extent. It was visible from the west of Ireland to the east of Poland, and from the 50th degree of north latitude throughout all the northern regions of Europe.

The *aurora borealis* has been variously ascribed to electricity, to magnetism, to a phosphorescent light, to the light of the sun repeatedly reflected from different regions of the clouds, to the zodiacal light, and to the inflammation of hydrogen gas, which, as Mr Kirwan, who proposes the theory, thinks, is generated in great abundance in various natural processes in the equatorial parts of the globe, and by its low specific gravity ascends rapidly into the atmosphere, and is kindled by electricity. But the true explanation of this meteor is still involved in obscurity. See METEOROLOGY.

AURUM, Gold, one of the precious metals; for the natural and chemical history of which, see CHEMISTRY and MINERALOGY.

AUSONIA, the ancient name of Italy, which is sometimes employed by the poets, and is derived from the early inhabitants, who were called Ausones.

AUSONIUS DECIMUS, or DECIUS MAGNUS, a Latin poet of the fourth century, was born at Bourdeaux in France, was educated under the care of a relation, professor of rhetoric at Thoulouse; and having made unusual progress in his studies, he returned to his native place, where he successfully taught grammar and rhetoric. The fame of his lectures reached the imperial court, and secured to him the good fortune of being appointed by Valentinian to superintend the instruction of his son Gratian; and as a requital for his services, he was raised to the chief offices of the state, first to that of quæstor, and afterwards to the distinguished station of consul. He stood high in favour with the emperor Theodosius, who promoted him to the patrician dignity, and urged him to publish his poetical works. He died near the end of the fourth century. The genius and poetry of Ausonius are allowed to be of a superior character to his cotemporaries. The edition of his works, with a French translation, published at Paris in 1769, in four small volumes, is reckoned one of the best.

AUSPEX, an appellation originally applied to the Roman augurs, or those who predicted future events from observing the flight of birds; but according to some, it was less limited in its application, and denoted generally any person who interpreted omens.

Auspices were consulted on all matters of importance by the ancient Romans; and it seems probable, that the system became a political engine which generals and statesmen employed for the purpose of facilitating or retarding those enterprises in which they were engaged, as best suited their views. Assemblies of the people were not legally constituted without a formal consultation of the auspices. The augur, by his report of the omen being unfavourable, had it in his power to delay the meeting, or, on pretence of some informality in the necessary solemnities, could dissolve the assembly in any stage of its proceedings.

AUSTERLITZ, a small town of Moravia in Germany, to which the sanguinary conflict between the French and allied Russians and Austrians, on the 2d of December 1805, has given great celebrity. On that eventful day, the Russians lost 15,000 men in killed and wounded, and 100 pieces of cannon. The French, in whose favour the fate of war decided the engagement, have called it the battle of the *Coronation*, because it was fought on the anniversary of Bonaparte's coronation; while the presence of three emperors on the field has suggested to others the seemingly more appropriate designation of the battle of *the three Emperors*.

AUSTIL, or AUSTEL, a thriving town of Cornwall in England, contains nearly 4000 inhabitants, who are employed in the tin mines in the vicinity, in the manufacture of coarse woollen stuffs, and in the pilchard fishery, is the seat of a stannary court; and the porcelain clay, which is dug out from quarries in the neighbourhood, is transported to the potteries in different parts of England.

AUSTRALASIA, or SOUTHERN ASIA, a division of the globe first proposed by M. de Brosses, and adopted by succeeding geographers, comprehends all that space included between the 3d degree of north latitude and the 50th degree of south latitude, and between the 95th and the 135th degrees of east longitude. Within the defined limits are placed the vast island, or rather continent, of New Holland; Van Diemen's Land; Papua, or New Guinea; New Britain, New Ireland, and other islands in the same group; Solomon's Islands, or the Arsacides; New Hebrides, New Caledonia, and New Zealand; of each of which a description will be found under its own name in the order of the alphabet.

AUSTRIA, a province or archduchy of Germany, is bounded on the north by Bohemia and Moravia, on the east by Hungary, on the south by Styria, and on the west by Bavaria. At its utmost length it extends to nearly 190 British miles, and its medium breadth is about 80; and holds a central situation between the European capitals, Petersburgh, Constantinople, Madrid, and London. Austria is divided into Upper and Lower. Upper Austria occupies the west side of the Ens, and Lower Austria lies on the east side of that river.

Austria.

General aspect.—The outline of Austria resembles that of an open book. The Danube occupies the middle space, and rolls his waters through the whole length of the province. The banks, on either side, rise by a gentle ascent till the sloping surface meets the mountains. Lakes and rivers, woods and wilds, pastures and meadows, cultivated fields and flourishing vineyards, enrich and diversify the landscape; and cities, towns, monasteries, villas, and farm-houses, adorn the scene.

Mountains.—As a noble river passes through this country in the centre, so also mountain groups guard its frontiers. Upper Austria may be denominated a hilly country. The northern, and still more the southern boundary, rises to a mountainous elevation, of which the loftiest summits are, Priel, 6565 feet above the level of the sea, Œtscher 5900, and Hassberg 5215. Schneeberg, or *Snowy mountain*, attracts the attention of every stranger that visits Vienna.

Lakes.—Here, as in other mountainous districts, water stagnates in the pent up vallies, which in Upper Austria form an assemblage of beautiful lakes. Of these the Traun, the Wolf-gang, the Aber, and the Hallstatter, are most considerable for extent of surface and beauty of scenery.

Rivers.—The Danube (the Ister of the ancients), is not only the noblest of Austrian, but of European streams. It rises among the mountains of Swabia, and, passing many stately towns, flows with a majestic current through Bavaria, Austria, Hungary, and European Turkey, when, after a course of more than 1500 miles, it falls, by many mouths, into the Euxine sea, and mingles its streams with the waters of the world. All the other rivers of Austria tend toward and join the Danube. The Ens, flowing from the south, forms the line of separation between Upper and Lower Austria. The Styer, the Ips, the Traun, and the Trasen, flow in the same direction, and are remarkable for the greenness of their waters, arising from the colour of the sand which they hold in suspension.

Climate.—Like other regions of diversified and elevated surface, the temperature of Austria is subject to much variety. On the banks of the Danube the heat, in summer, is occasionally excessive, while, during a great part of the year, snow capes the mountains. The mean temperature of the springs is from 47° to 50° of Fahrenheit. In the upper districts the weather is inconstant and variable; transitions from heat to cold, and from cold to heat, are sudden and severe; and premature frosts, high winds, and heavy rains, frequently blast the hopes of the husbandman, and induce chronic complaints among the inhabitants. But the climate of Austria is, on the whole, favourable both for vegetation and health.

Soil and Produce.—The soil of Austria is composed either of deep alluvial deposites, or accumulations of gravel from the mountains. Among the mineral productions of Austria may be mentioned gold, which has been found in the vicinity of Krems, and silver in the mountains towards Styria. The salt of Upper Austria is a copious source of riches and revenue. The hot springs of Baden are well known; and with regard to vegetable productions, this country abounds with all those European plants which require a lofty or a low, a cold or a warm, an exposed or a sheltered situation, or which thrive in a rich or a poor, a moist or an arid soil. It is more fertile in corn and wine than most of the other German provinces. Its tobacco yields a considerable revenue; its saffron has long been esteemed the best in the world; and its mountain slopes are clothed with forest trees of great variety, and of an excellent quality. The animals of Austria,—its horses, cattle, sheep, goats, game, and poultry,—are numerous, and all deemed excellent according to their kinds. Its rivers, too, teem with numerous species of fishes.

Population.—The population of this province exceeds 1,500,000. Of this number more than 17,000 are foreigners, attracted to the schools and court of Vienna, or to the manufactories of the country. The nobility amount to nearly 4000, and the clergy to upwards of 4500.

Cities.—Besides a numerous and respectable peasantry, the population of this province is distributed among a multitude of cities, towns, and villages. Vienna, the metropolis of all Germany, and the residence of the imperial court, contains in the city and suburbs 256,000 inhabitants. Lintz, the capital of Upper Austria, has a population of 17,000 souls. The other considerable towns are, Krems, with 7000 inhabitants, Wiener Neustadt 5000, Waidhofen 4000, Kloster Neuburg 3000, Ens 4000, Freystadt 4000, Gmunden 3000, Wells 3000, together with many more of inferior note.

Agriculture.—Considerable attention is paid to the cultivation of this fertile region. The old system of management prevails; but an approximation is made to a regular rotation of white and green crops. The fields are secured against the irruption of rivers. The sloping surface of the country lays the cultivator under little necessity to study the principles, or to practice the art of draining. Irrigation is employed with success, and marl is used as a manure. Wine is the principal produce of Lower Austria. It is overspread with vineyards, from the grapes of which a wine of an acid taste, but of a wholesome quality, is prepared

Manufactures.—Austria has some claim to the appellation of a manufacturing country. Fabrics of woollen, silk, and cotton, are formed in its several towns. Vienna has many manufactories, for leather, paper, porcelain, glass, iron, steel, &c. for household furniture, toys, &c. The woollen manufactures of Lintz and its vicinity afford employment to more than 10,000 workmen. The preparation of salt gives scope to the industry of the inhabitants of Gmunden and some of the other towns of Upper Austria.

Religion.—The Roman catholic religion is established and prevails throughout the province. Toleration however is, under the sanction of law, extended to every other species of religious profession. The crown is patron of the church. The archbishop of Vienna is head of the clergy. The maintenance of the church is expensive. Under the influence of this corrupted Christianity, ignorance is deep and general, and the improvement of the human mind sadly retarded.

Government.—The emperor in this hereditary domain is almost absolute. In him the legislative and

Austria.

the executive power resides. He is the supreme judge and the source of honour. It belongs to him to impose taxes, to regulate the affairs of the church, and even to modify religious worship. Maria Theresa divided the executive government into four departments, —for domestic, foreign, and military affairs, and for the affairs of Hungary in particular. The whole jurisprudence of the country has lately undergone a complete revisal. The criminal code, in its amended form, was introduced into practice in 1804; and that for the regulation of civil matters was finally adopted in 1812.

Army.—Though Austria be a great military power, little is known with certainty respecting the actual state of her army. Recruits are first levied for the militia (landwehr), and thence the regular regiments are formed or filled up. A regiment consists of two field battalions, a battalion of reserve, and about 200 grenadiers, upwards in all of 3000 men. The active and hardy habits of the Austrian fit him for bearing the fatigues, the privations, and the dangers of the camp and of the field. There are public establishments for the instruction of the young officer; and the hospital of Vienna affords an asylum to the wounded and worn-out veteran. The time of service is limited as in the British army.

Revenue.—The resources for the exigencies of the state arise from heavy and numerous imposts. The imperial domains are said to yield an annual revenue of about L.100,000 Sterling. Taxes are levied on land, houses, mines, minerals, salt, tobacco, wine, &c. &c. also on places, pensions, postage, lottery-tickets, stamps, &c. Austria, like other European states, is deeply involved in debt,—not less, according to the latest information, than 150 millions Sterling.

Austria, house of.—The imperial family of Germany owes its origin to an illustrious founder. Rodolph, the first of this line, while count of Hapsbourg, was eminent for mental capacity and manly accomplishments, for justice, generosity, and humanity. His father's last advice was well fitted both to excite the love, and to direct the pursuit of honourable distinction. Actuated by the enthusiasm of the times, he had embarked in the crusades; and, previous to his departure to Palestine, he summoned his sons into his presence, and admonished them to remember, that the counts of Hapsbourg, their ancestors, had attained their greatness, not by violence and outrage, but by wisdom and courage, exerted in the cause of their country. He died in Syria; Rodolph succeeded to his honours; and in 1245, he married Anne of Hohenburg, who brought him some domains in Alsace. In those days of incessant appeals to the sword, Rodolph was obliged to be much in arms; his wars were waged, not for aggression, but for expelling hordes of banditti who infested the country, for humbling the nobles, who delighted to domineer over the industrious citizens, and for checking the ambition of the church, which the prelates disguised under the mask of religion.

While thus actively employed, he was astonished with the intelligence that he was unanimously elected king of the Romans. This happened in 1273, in the 55th year of his age. On his accession to the throne, it soon became conspicuous, from the elevation of his mind, and from the wisdom as well as the splendour of his actions, how well he was fitted to sway a sceptre. His first care was to conciliate the church; and he had the address to attach the pontiffs in succession to his interests. He adjusted intestine quarrels, and enacted wise laws; and then prepared to chastise the audacity of Ottocar, who having himself expected the imperial crown, had, in the paroxysm of his disappointment, loaded his rival with every species of insult. This powerful antagonist was soon obliged to sue for peace, which he purchased by renouncing his claims to Austria and the adjacent provinces, and by doing homage for the possessions he was permitted to retain. After this successful war, Rodolph entered Vienna in triumph, and was received with acclamation. A violation of the conditions of peace, however, which the proud spirit of Ottocar had acceded to with reluctance, soon provoked a renewal of hostilities. The adverse armies marched and met, and engaged in cruel conflict. In this bloody battle Ottocar was slain with 14,000 of his followers, among whom were many illustrious names. From this time Rodolph incorporated Austria with his hereditary domains, and spent the latter years of his life in peace, though not in idleness. His demise is dated in 1291. When (to employ the words of Mr Coxe) "we consider the greatness of his actions, and the smallness of his means; his extreme prudence and address; his ardour for military glory, yet his propensity to peace; his firmness in distress, and what is far more difficult, his moderation in prosperity; his shining talents as a sovereign, and his amiable qualities as a man,—we must place Rodolph among the best and greatest princes who ever filled a throne."

The same policy which had opened to Rodolph an access to the throne, operated against the succession of his son. During the preceding century the majority of the German electors had imagined, that to preserve their freedom entire they should never suffer the imperial power to reside, or to descend in the same family. Acting on this absurd principle they cherished among themselves the evil genius of discord; through whose influence Albert, the sole surviving son of Rodolph was superseded by Adolphus count of Nassau. But having at last triumphed over his rival, he obtained possession of the throne, which the hand of an assassin permitted him not to enjoy. After this tragical event the house of Austria sunk, and for a long series of ages continued in a private capacity. But the stock was fresh in the earth, and sent forth many a stately branch; though its ramifications were too numerous to command strength to repel the storms by which it was assaulted. More than a century had elapsed from the demise of Albert I. when his descendant, of the same name, was in 1437 chosen king of the Romans. After a short reign he was succeeded by his cousin Frederick, who experienced many vicissitudes of fortune; who, after many exiles and much wandering, saw before his death the re-union of the hereditary dominions of his house; and, by means of three successive marriages, the house of Austria, recently so low, became by the accession of Burgundy, Spain, Hungary, and Bohemia, the most powerful in Europe. To every reader of history, the names and mighty transactions of

Maximilian, Charles V. and their successors, are familiar.

On the death of Charles VI. in 1740, the family of Rodolph the Great became extinct in the male line. He left an only daughter, the far-famed Maria Theresa, espoused to Joseph, duke of Lorraine. This young and beautiful princess was at first involved in the most trying circumstances. On her accession to the hereditary crown of Hungary, she found an exhausted treasury, a disaffected people, inefficient councils, and powerful foes in league against her; yet with all the timidity, the softness, and delicacy natural to her sex, she yielded not up herself a victim to despair, but roused the energies of her mind to sustain the exigencies of her fortune, and saved her country by her courage. The king of Prussia had occupied Silesia, and threatened greater aggressions. In this extremity, the queen of Hungary convoked at Presberg the states of the kingdom, and presented herself before them, invested with the antique crown of the country, and the tattered robe of St Stephen. "The existence, (she said in Latin,) of our kingdom, of our person, of our children, and of our crown, is now at stake. Abandoned by all besides, we place our whole resources in the fidelity and valour of our long-tried Hungarians." This appeal of beauty in distress was not made in vain. With their hands on their swords, the deputies exclaimed, "we will consecrate our arms, our lives,—we will die for our sovereign Maria Theresa." A liberal supply of men and money was voted: Troops were collected from all quarters: Vienna was put in a state of defence; and the burghers and the students vied with the garrison to make a desperate resistance. By these means promptly applied, and the intervention of jealous feelings among her enemies, Austria was saved. After a long and a tumultuous life, Maria Theresa expired in 1780.

Long before this event, her son Joseph II. had been proclaimed king of the Romans. And, on his father Joseph of Lorraine's decease, he obtained the title of Emperor. Joseph II. was a man of a restless and an innovating disposition. These defects of his character his mother observed with regret, and sought to correct. He introduced many changes, some of which had a beneficial tendency, but most of them were eminently pernicious.

Leaving no child, he was, on his death in 1790, succeeded by his brother Leopold II. who was soon involved in the French revolutionary war. On his decease in 1792, his son, Francis II., succeeded to the crown, which he still wears. A better opportunity than the present will occur to introduce the details of the Bonapartian wars, in which the house of Austria was so deeply concerned. But it may be noticed, that Francis, overwhelmed by his enemy, relinquished, in 1804, the title of emperor of Germany, and became a vassal of France; that in 1810 he sacrificed his eldest daughter Maria Louisa to pacify his conqueror; and that in 1815 his capital became the scene of those arrangements which have given tranquillity to Europe, and restored him to his honours and influence.

AUTOMATON, from the Greek, and signifying to *move itself*, is a self-moving machine; but the term is usually limited to those machines which imitate the actions of animals, and even of man himself. When the automaton, or self-moving machine, is in the human form, it is called *Androides*, which denotes the *resemblance of man*. Mechanical ingenuity has been industriously employed in all ages, in the construction of machines of this description. If full credit can be given to the relations of authors, the ancients were not deficient in this application of mechanical skill. Dædalus constructed statues, which, it is said by Aristotle, moved about by means of quicksilver; and Archytas of Tarentum, who lived 400 years before the Christian era, contrived and executed a wooden pigeon, which could raise itself in the air; Friar Bacon, who lived in the 13th century, formed a brazen figure which imitated human speech; Albertus Magnus, who flourished about the same period, occupied 30 years of his life in the construction of an artificial man: And John Muller of Nuremberg, better known by the name of Regiomontanus, made a wooden eagle, which took a flight through the air, saluted the emperor Maximilian as he approached Nuremberg, and having returned, waited his arrival at the city gates. But some of these accounts are too much veiled in fable, and others are too vague and exaggerated to afford precise information. Of the numerous specimens of extraordinary mechanism which the ingenuity of modern times has furnished, a few may be specified.

The Flute-player.—In the year 1736, M. Vaucanson, member of the royal academy of Sciences, exhibited at Paris an Androides, which played several airs on the German flute. The machine was composed of a figure five and a half feet in height, seated on a fragment of rock, which was supported by a pedestal four and a half feet high by three and a half feet broad. When the front of the pedestal was opened, the clock-work was seen, by the operation of which a steel axis was put in motion. To various protuberances on this axis, were attached cords, which being passed over pullies, terminated in the upper boards of nine pairs of bellows, which, by the revolution of the axis, were alternately elevated and depressed. The valves were opened by levers, which produced a uniform unbroken sound. The air discharged by the nine pairs of bellows was received into three tubes, which conveyed it to three small reservoirs placed in the trunk. Here the tubes were united into one, which was continued to the throat, and formed the cavity of the mouth. Three pairs of bellows were attached to each of the three pipes. The upper boards of one set were depressed with a weight equal to four pounds; those of the second set, with a weight equal to two pounds; and those of the third with their own weight. In this way the air was furnished to the machine.

By means of another series of machinery, the requisite movements were communicated to the lips, the tongue, and the fingers. All this was effected by the revolutions of a cylinder, in which brass pegs were inserted for raising and depressing fifteen levers, seven of which, through the intervention of steel chains and pullies in the body and arms of the figure, regulated the action of the fingers in opening and shutting the holes of the flute; three levers which

Automaton. were connected with the valves of the three small reservoirs, were employed in regulating the current of air for the modification of the tone; four of the levers acted upon the mouth in the same way, and gave the proper motions to the lips, and the last lever moved the tongue, by which the mouth of the flute was shut and opened. By means of an endless screw, which terminated the axis of the cylinder, a new series of revolutions was communicated to the levers, during twelve different revolutions. The screw consisted of twelve threads, placed at the distance of a line and a half from each other. Above the screw was fixed a piece of copper, in which a steel pivot was inserted; and this pivot, working in the threads, produced a change of position in the cylinder, during every revolution of the axis, and thus brought into action different pegs on different levers. By an artificial disposition of the pegs on different parts of the cylinder, the statue was made, by the successive elevation of the different levers, to exhibit all the requisite variety of motions in a flute-player.

To give a single example, let it be supposed that the lowest note of the flute, D, is to be sounded,—this is effected by closing all the holes of the instrument with the fingers, and by gently blowing into it a full body of air. To give the mouth the proper form, a peg is fixed in the cylinder under the lever, which is destined to enlarge the lips; another peg is placed under the lever which draws back the lips; another under the lever for opening the valve of the reservoir which communicates with the unloaded pair of bellows; and lastly, a peg is inserted under the lever, which regulates the motions of the tongue, for the purpose of giving the proper articulation to the note. If all these pegs operate on their proper levers at the same moment, the sound required must obviously be produced. By raising the third finger of the right hand, and opening the sixth hole of the flute, and continuing the former motions, the note E, which is next in the scale, is sounded. Here a fifth motion is added, which is done by inserting a peg in the cylinder under the lever which acts on the third finger of the right hand. Proceeding in this way, all the notes of the first or lowest octave are sounded. To produce the notes of the second octave a change must be made on the mouth, and the air must be forced out with greater velocity. This is effected by opening the reservoir, which is supplied by the pair of bellows loaded with two pounds; and in the third octave another change must take place on the mouth, and the air is conveyed with still greater velocity from the reservoir to which the bellows loaded with four pounds are attached.

M. Vaucanson, in the year 1741, exhibited to the royal academy of Sciences another musical Androides, in the form of a shepherd, which performed about twenty different tunes on the pipe and tabor. The flageolet was held in one hand, and to produce the highest tone of the instrument the bellows required to be loaded with a weight equal to 56 pounds, while a single ounce was sufficient for the lowest note. The other hand held a stick for beating the tabor. Sometimes the strokes were single, sometimes double, and sometimes a rolling noise was produced. This automaton was regarded as a very extraordinary effort of mechanical skill and execution.

Chess-player.—A still more wonderful piece of mechanism was constructed and exhibited to the public in different parts of Europe, by M. Kempelen, a gentleman of Presburg, in Hungary, in a figure of the size of life, which not only played the complicated game of chess, but it is said usually beat even the best players. This figure was exhibited in Britain in 1783 and 1784, and excited no small degree of astonishment in those who had an opportunity of witnessing its extraordinary performance. It was dressed in a Turkish habit, and seated on a chair behind a table with doors. The chair was connected with the table. The whole apparatus was moved about the apartment on four wheels. By inspecting the table and the body of the Androides, nothing appeared but wheels, cylinders, and levers; after this examination was finished by the spectators, the game commenced by the automaton taking the first move; at every movement the machinery was heard, which was accompanied with a motion of the head, as if the figure cast its eyes over the board to consider the state of the game. When a false move was made it shook its head; in checking the queen it shook the head twice, and three times to the king. After every ten or twelve moves the machine was wound up like a watch, and the inventor, or his assistant, was always at hand, and frequently consulted a small square box, in which it was said the whole secret lay. The directing power of this machine was long altogether inexplicable. But it was at last ascribed to the operation of a well-taught boy, so thin and small of his age that he could be concealed in a drawer under the chess-board; or to a dwarf, an expert chess-player, who was kept out of view, by changing his place during the examination of the apparatus previously to the commencement of the game. These allegations were made in two publications concerning Kempelen's chess-playing Androides, one of which appeared in Germany, and the other in Paris in 1785; and the movements of the adversary were supposed to be observed through a transparent chess-board, or were indicated by levers or some pantographical contrivance. See AUTOMATON in *Supplement* to Hutton's *Mathemat. Dict.*

Speaking Androides.—The same ingenious person made the bolder attempt of constructing a machine capable of imitating human speech. While M. Kempelen visited London with his chess-player, he exhibited this machine in an unfinished state; but it is said that he could make it pronounce any word that was mentioned by those who were present. According to all accounts, the imitation was extremely imperfect, both with regard to the individual sounds, and the rapid succession necessary, even in a distant approach to the resemblance of the wonderful variety and extraordinary execution of the human voice. It was assuredly far inferior to the harsh and discordant speech of the deaf and dumb, in whom the organs are perfect, but the power of modulation is deficient. The defects of the mechanical contrivance extend to the construction and nice adaptation of the different parts, as well as to the imitative expression.

Rope-dancers, &c.—Figures which imitate all the motions of rope dancers, have been constructed and exhibited in this country, chiefly by ingenious foreigners. An Androides of this description, as large as life, formed part of an entertainment with which M. Philipstahl amused the inhabitants of many of the towns of Great Britain about the year 1801, or 1802. Among many examples of great mechanical ingenuity exhibited about 1804 and 1805, in different parts of this country, by M. Maillardet, a native of Switzerland, one figure as a boy wrote several lines with neatness and accuracy, and sketched three beautiful landscapes; another figure in a female habit performed pieces of music on an instrument which acts as an organ, but is constructed like a piano-forte, the bellows being blown by some part of the machinery, and the whole of this complicated apparatus being set in motion by six powerful springs; and a small figure, in the character of a conjuror or magician, who gives appropriate answers to questions inscribed on medallions, which are put into a drawer, and the drawer being shut the magician solemnly rises from his seat, consults a book which he holds in one hand, and waves a wand in the other, when a pair of folding doors fly open, and the answer appears.

A description is given by M. Camus of a very curious piece of mechanism, which he invented and constructed for the amusement of the celebrated Louis XIV. of France, when a child. A small coach, in which was seated a lady, was drawn by two horses, and attended by a footman and page, who stood behind it. The coach was placed on a table, the coachman smacked his whip, the horses moved their legs, and when the carriage, after proceeding along the edge of the table, and turning at the angles, reached the place near which the king sat, the page jumped down and opened the door, the lady alighted, curtsied to the king, and presented a petition; and having waited a little, curtsied again, and resumed her place in the coach, which afterwards moved off. Ozanam's *Mathemat. Recreations*, by Montucla.

M. Vaucanson, the inventor of the flute-player, constructed an artificial duck, which not only imitated the different motions of the animal in a very exact and natural manner, but *seemed* also to have the power of digesting the food which it swallowed; from which it is to be understood, that by some contrivance, whether by mechanical mixture or chemical action with other substances previously introduced within its body is not known, it had changed its appearance. M. Maillardet constructed a spider, which ran round a table for two or three minutes; and one of the most curious productions of the same ingenious artist, was a box about the size of an ordinary snuff-box. The machinery in this apparatus was put in motion by springs; and when wound up, and the box was placed on the table, the lid opened, a bird with the beautiful plumage of the humming-bird, and not larger, sprung up from its nest, fluttered its wings, began to warble with tremulous notes, and continued to sing for some time, when it darted again into its nest, and the lid closed after it.

AUTUMN, the third season of the year, is represented in painting under the figure of a man of full age, bound round the middle with a starry girdle, and having in one hand a balance, with a pair of scales, in each of which is placed a globe, and holding in the other a bunch of grapes and various other fruits. The progress of the season is indicated by his perfect age and the collection of fruits; and the balance denotes the sign of the zodiac which the sun enters at the commencement of autumn.

AUTUN, a town in the department of Saone and Loire in France, can still boast of some remains of Roman antiquity, in the ruins of temples, a theatre, and other buildings; contains a population of 9000; and from the surrounding country supplies Paris with large quantities of wood for fuel and other domestic purposes. Coal and iron ore are dug out in the vicinity; and the town derives an abundant supply of water from the springs which have their source in the mountains at the foot of which it is situated.

AUVERGNE, a former province of France, is included, according to the new division, under the departments of Cantal and Puy de Dome.

AUXERRE, the capital of the department of Yonne in France, stands in a commodious situation on the declivity of a hill, and is surrounded with rich and beautiful scenery. The cathedral and the episcopal palace have been greatly admired for their magnificence. The population is estimated at 12,000. The trade in wines, some of which, as the Coulange and the Chablis, are in high repute, is considerable; and from this place Paris receives a large supply of timber, which is transported by water carriage on the Yonne and the Seine.

AUXONNE, a small fortified town in the department of Cote d' Or in France, is chiefly remarkable for its long bridge of 23 arches, and extended pavement or causeway, both which are necessary to obviate the inconveniences of inundations of the Saone, on whose banks it is situated; contains more than 5000 inhabitants, and has some trade in timber and corn.

AXIM, a district of the Gold Coast in Africa, was originally in possession of the French, who, in 1515, were expelled by the Portuguese; and the latter, in their turn, were dispossessed by the Dutch, who afterwards shared the territory with the Prussians. The soil is rich and fertile, and produces abundance of rice, millet, yams, palm oil, and excellent fruits. Black cattle, sheep, goats, and poultry, are successfully reared. Gold dust, ivory, and formerly slaves, with the manufacture of salt, and the building of canoes, are the chief objects of commercial industry, or afford occupation to the inhabitants.

AXIOM, a truth or proposition which requires no demonstration or train of reasoning to establish it, but is self-evident, or obvious to every person at first sight. Thus, *the whole is greater than a part*, is an axiom in geometry.

AXMINSTER, a small town of Devonshire in England, was a place of some note in the time of the Saxons, but is now chiefly distinguished for its manufactory of carpets, the fabric of which is an imitation of the celebrated Turkey carpets. Axminster contains a population of more than 2000, and it enjoys an excellent weekly market.

AXUM, or AXUMA, once a flourishing and populous city of Abyssinia, and the capital of the kingdom, till it was destroyed by the Turks about the beginning of the 16th century, is now only conspicuous for its magnificent ruins. Several obelisks of single blocks of granite, one of which reaches to the stupendous elevation of 80 feet, and even the smallest are 36 feet in height, yet remain, the striking monuments of its ancient splendour.

Axum is seated in a valley, of which the soil is rich and productive. The modern town contains about 600 houses. Coarse cotton cloth, and parchment made from goats skins, are the chief manufactures.

AXYRIS, a genus of plants belonging to the Monoecia class.

AYENIA, a genus of plants belonging to the Pentandria class.

AYLESBURY, a very ancient town of Buckinghamshire in England, is finely situated in the rich vale of Aylesbury, was a place of some note even before the time of the Saxons, and was granted to William of Aylesbury by William the Conqueror, on the peculiar conditions of finding straw for the king's bed, and three eels for his table in winter; and straw for the bed, sweet herbs for the chamber, and three green geese for the table in summer; and this provision was to be made three times a year, if required. Aylesbury is the seat of the quarter sessions of the county and the Lent assizes; the number of inhabitants exceeds 3000; they are chiefly occupied in the manufacture of lace; and it is 17 miles from Buckingham, and 40 miles north-west from London.

AYR, a maritime county of Scotland, which has the frith of Clyde and the Irish channel as its boundary on the west, for an extent of between 70 and 80 miles from its northern limit, where it joins Renfrewshire, to its southern extremity, where it is united with Galloway. The counties of Lanark and Dumfries mark its confines on the east; and, in somewhat of a crescent form, the greatest breadth is estimated at 32 miles. The computed area is more than 1000 square miles; it is divided into three great districts,—Carrick, lying to the southward of the river Doon; Kyle, occupying the intermediate space between the Doon and the Irvine; and Cunningham, which comprehends the northern portion. The Great and Little Cumbray, and the rock of Ailsa, are also included in the county.

General aspect.—In its general appearance, Ayrshire presents considerable variety. In several places extensive flats stretch along the shores; in others a gently undulating surface is the chief feature; and towards the interior, and in the southern district, it is to be regarded rather as a hilly country than rising into a mountainous elevation. The sand-floods have left some dreary wastes along the shores of Ayrshire; and it would appear that, in certain instances, the date of this calamitous visitation is not very ancient. An old map still in existence represents the extensive tract of sand-hills between Saltcoats and Irvine, covered with arable land, and studded with farm-houses.

Rivers, &c.—The rivers of this county are the Ayr and the Doon, to which the muse of Burns, their native bard, has added classic celebrity, the Garnock, the Irvine, the Girvan, the Stinchar, and their tributary streams. The banks of the chief rivers present numerous beautiful and picturesque scenes; and they are adorned with many elegant mansions, the family residences of the great proprietors. Loch Doon, which is seven miles long, and is the source of the river of the same name, and Kilbirnie loch, near Beith, in the northern district, are the principal lakes. The waters of Ayrshire abound with fish; and where the larger rivers discharge their waters into the ocean, fisheries of salmon are successfully conducted. The white fisheries along the shores are also profitable sources of employment.

Natural history.—Ayrshire abounds in some places with coal. Extensive tracts of that valuable mineral are deposited in the vicinity of Saltcoats, Irvine, Kilmarnock, and Ayr, from which large quantities have been long dug out, not only for home consumption, but for exportation to Ireland. The vale of Girvan, in the district of Carrick, affords also an ample supply of coal to the surrounding country for domestic and agricultural purposes; and repositories of the same mineral, of less limited extent, are numerous in the interior of the county. Limestone is not less abundant, although it be found economical to import it sometimes from the north of Ireland as ballast or as a return cargo. The sandstone in Kyle and Cunningham is of an excellent quality for building, and it is sometimes exported to Ireland. The iron-works of Muirkirk and Glenbuck are supplied with all the necessary materials of their manufactory. Lead ore is not to be considered a copious production, but attempts have been made to work it in a few places; and Ayrshire can boast of the only mine of the rare mineral *plumbago*, or black lead, excepting that of Borrowdale, in Britain. The *Water of Ayr stone*, a whetstone of an argillaceous quality, much valued by carpenters for their edge-tools, is dug out from a single spot on the banks of the river from which it derives its name.

The prevailing rocks in the southern district of Ayrshire are grey wacken of modern mineralogists, and when the same rock assumes a schistose or slaty structure it is applied to the purposes of roof slate; secondary limestone, of which considerable masses appear, and are extensively wrought for the improvement of the soil; and red sandstone, which is visible in a few places along the shore. Brown Carrick hill, near Ayr, is composed of porphyry, which affords indications of lead ore. In the middle district, beside the coal strata, an extensive tract of red sandstone traverses the interior, and runs from north to south; and the same rock commences near Saltcoats, and continues along the shore beyond the northern limit of the county.

Botany.—The Flora of Ayrshire includes some plants which may be accounted rare in Scotland, or are chiefly confined to the western districts. The lover of botany, whose excursions shall be directed that way, may be gratified in knowing where to find them in their native soil. *Pulmonaria maritima*, sea-bugloss, reckoned one of the most beautiful indigenous plants of Great Britain, occasionally springs up, the solitary ornament of the barren shores of Kilbride, and with its finely undulated azure leaves, contrasted with red and blue flowers, diversifies the arid scene. *Samolus valerandi*, water pimpernel, grows on the sea-marsh between Hunterston and the sea. *Sison verticillatum* (*Sium verticil.* of Dr. Smith), whorled water parsnip, in moist pastures in Kilbirnie parish. *Lysimachia Thyrsiflora*, tufted loosestrife, a very rare plant in Britain, which we were fortunate in discovering several years ago in Ashgrove loch, two miles north-east from the village of Stevenston. *Rosa cinnamomea*, cinnamon rose, on the east bank of the Garnock, above Kilwinning. *Nymphea lutea*, yellow water lily, in Ashgrove loch. *Iberis nudicaulis*, rock cresses, on sandy pastures near the old coal-pits of Misk, on the banks of the Garnock. *Sisymbrium monense*, Isle of Man rocket, clothes the pastures or downs along the whole coast of Ayrshire with its elegant pinnated leaves and yellow flowers. *Sisymbrium amphibium*, jagged water rocket, in some of the old canals at Stevenston coal-work. *Hypericum Androsæmum*, tutsan or parkleaves, one of the most splendid native plants, adorns the woods of Lord Glasgow's seat of Kelburn. *Solidago lanceolata*, spear-leaved golden-rod, which we observed, in 1814, in great profusion on an old coal-hill on the north side of the road between Maybole and Girvan, and nearly opposite to Kilkerran, the seat of Sir James Ferguson. *Osmunda lunaria*, moon-wort, on the sandy downs between the village of Stevenston and the sea. *Osmunda regalis*, royal flowering fern, displays its elegant leaves, and conspicuous flowering stem, from the crevices of the rocks of an old quarry, close by the house of Ardeer, near the same village; and *Equisetum hyemale*, Dutch rushes, grows on places where the water stagnates in winter, at the head of the Newton-green, near Ayr.

Population, towns, &c—The population of Ayrshire, within the period of little more than half a century from 1755, has nearly doubled. In 1755 the number of inhabitants was estimated at 59,268; in 1801 at 84,306; and in 1811 at 103,954. The real rent of lands and houses in 1811 amounted to L.359,294 Sterling. The county is divided into forty-nine parishes. The chief towns are Ayr, the capital of the county, and Irvine, both royal boroughs and sea ports; Saltcoats, Ardrossan, and Troon, also sea ports; Girvan and Ballantrae, which admit small vessels into their harbours; Kilmarnock, which has been long famous for manufactures of woollen stuffs, chiefly carpets, and of leather; Maybole, Cumnock, Mauchline, Catrine, Beith, and Kilwinning. The new town and harbour of Ardrossan, begun under the auspices of the Earl of Eglinton, when completed, will be highly advantageous to the trade of that coast; its fine situation, and excellent baths, render it a commodious and delightful watering place. Troon, on an intermediate spot between Irvine and Ayr, affords a similar example of patriotic spirit, in the splendid operations of forming a harbour, building a town, and constructing a railway ten miles in length, for the purpose of easy communication with Kilmarnock and its populous vicinity, which have been undertaken and executed by the duke of Portland. A single horse used to draw three tons ascending, but favoured by the declivity towards the shore, five tons weight; and 100 tons of coals have been shipped in a day by this railway. The new application of the steam-engine is now adopted as the moving power to the carriages. Catrine, which numbers 3000 inhabitants, dates its origin and remarkable increase to the introduction and establishment of the cotton manufactory within the last thirty years. The power of water and of steam is successfully employed in the spinning and weaving of cotton.

Husbandry.—Ayrshire, in general, has been supposed to be less advanced in agricultural improvements than some other districts of Scotland. But examples are not wanting of successful cultivation both among proprietors and tenants. The stiff clay soil in the interior districts, and the moist climate, render the crops late and precarious; but they are earlier and more certain on the light loamy soils on the plains near the shores. The hilly tracts of country afford excellent pasture to sheep and cattle. The management of the dairy has been long an object of successful attention in Ayrshire, and the superiority of Dunlop cheese is generally acknowledged. The improvement of peat-moss, which is one of the most important in modern agriculture, and has clothed many barren wastes with luxuriant crops or rich pastures, was first suggested by Mr Smith of Swincridgemuir in this county.

Trade.—The commercial intercourse of Ayrshire extends to Ireland, America, and the Baltic. Coals, to the amount of 100,000 tons, have been exported in one year to Ireland. Beside the coasting trade, the imports are, Irish produce, as grain, butter, and beef; hemp, iron, and timber from the Baltic; and timber from America.

Antiquities.—Numerous remains of ancient baronial residences are seen in Ayrshire. The abbacies of Crossraguel and Kilwinning were richly endowed; the territory which they held constitutes a valuable part of the possessions of the lay proprietors who had the power or influence to come in for a share on their suppression; and the mouldering ruins of the first still attest its former splendour. The Lazar-house, known by the name of *King case*, perhaps from *casa*, "cottage," or *Killcase*, signifying "the cell of the cottage," is a peculiar institution in the parish of Priestwick, two miles from Ayr, which was destined for the reception and maintenance of eight persons afflicted with leprosy. Lame and infirm persons have long enjoyed the benefits of the charity, which consist of a portion of meal, butter, &c. from certain lands in Carrick, the patrimonial domain of the royal founder. The right of presenting to this charity formerly belonged to the Wallaces of Craigie. The ruins of Alloway church, three miles from Ayr, would scarcely merit notice among the antiquities of the county, had they not been destined to future fame in one of Burns's finest productions, in which the legendary lore of the country is artfully embodied, and the versatile powers of the poet are finely displayed, in the exact delineation of human character, in sublime and terrific description, and in the expression of comic humour, delicate satire, and pathetic feeling.

AYR, town of, the capital of the county of the same name, stands on the southern bank of the river Ayr, and near its junction with the sea, is a place of considerable antiquity, as appears from its charter, granted about the end of the 12th century, and in former times was noted as a strong-hold. Oliver

Cromwell deemed it of such importance as to erect a regular citadel, defended by six bastions, part of which is still entire. Within its area the old church of St John the Baptist was included, and was converted into an armoury by the usurper, who granted 1000 marks, or L.666, 13s. 4d. for building another church. The tower of the old church only remains, and is a conspicuous landmark to the mariner in approaching the shore. The streets are not very regular, but some are spacious and airy; and houses lately erected are commodious and elegant. An academy, at which more than 500 pupils are ably instructed in the knowledge of languages, and in various practical branches of education, was established in 1790, and continues to flourish.

In 1801 the population was estimated at 5492, but in 1811 it had increased to 6291. They are employed in tanning, soap-making, weaving, ship-building, and in trading to Ireland, the Baltic, and America. Shipping, to the amount of 5000 or 6000 tons, belongs to the port; and 50,000 tons of coal are annually exported to Ireland.

Connected with Ayr, by means of two bridges, which are commemorated in the poetry of Burns, and seemingly forming part of the town, are Newton-upon-Ayr and Wallacetown; the first an ancient borough of regality, held by a singular tenure, now a distinct parish, and containing nearly 2000 inhabitants, who are chiefly occupied in fishing, rope-making, and weaving; and the last a modern village, included in a country parish.

The Chevalier Ramsay, the celebrated author of the *Travels of Cyrus*, was a native of the town of Ayr; and few readers need be informed that Robert Burns was born in a clay-built cottage in the annexed parish of Alloway. Ayr is 34 miles distant from Glasgow, and 76 miles from Edinburgh.

AZALEA, American upright honeysuckle, a genus of plants belonging to the Pentandria class.

AZIMUTH, a term in astronomy, applied to an arch of the horizon intercepted between the meridian of the place and the vertical circle, passing through a star or other body in the heavens, whose azimuth is to be determined. See Astronomy, p. 497.

AZOF, a town of Cuban Tartary, under the dominion of Russia, stands near the mouth of the Don, and has been subject, at different periods of its history, to the Genoese, Turks, and its present masters. The population is estimated at nearly 4000; but the inconvenience of the harbour, which has been gradually filling up with sand, and other causes, have produced a decline of the trade.

AZOF, Sea of, an inland sea, forming part of the Russian empire, has a communication, by a narrow strait, with the Euxine sea, lies between the 45th and 47th degrees of north latitude, and between the 34th and 39th degrees of east longitude, and is about 200 miles long and 50 miles broad. Extensive and successful fisheries are established on the northern shores Taganrok is the chief harbour, and enjoys a valuable commercial intercourse with Natolia and the Crimea. During a severe shock of an earthquake, in September 1799, an island rose above the surface of its waters; and its emersion was accompanied with a loud noise, like the discharge of artillery, and with a copious eruption of smoke and flame. Pallas' *Travels.*

AZORES, or Western Isles, a cluster of nine islands, lying in the Atlantic ocean, between the 36th and 40th degrees of north latitude, and between the 25th and 33d degrees of west longitude, were originally discovered by the Flemings in 1439, and now acknowledge the authority of Portugal. The Azores enjoy a fine climate, and produce grain, excellent fruits, and a good deal of wine; but they are subject to severe storms, and to the more dreadful visitations of earthquakes and volcanoes.

St Michael,—which is the largest of the Azores, is about 80 miles long, and from 6 to 12 miles in breadth, and presents a varied surface of extensive plains, covered with excellent crops of wheat, barley, and Indian corn; conical hills, whose sides are clothed with vineyards and orange plantations; and lofty mountains, adorned with luxuriant evergreens, among which the laurel and myrtle are not the least conspicuous. The chief towns, Punta del Gada and Ribeira Grande, contain each about 12,000 inhabitants; and some of their churches and religious houses are elegant structures. The whole population is estimated at 90,000. Hot springs are numerous; and the boiling fountains and muddy crater, in a state of constant agitation, in the valley of Durmas, with the copious deposition of sulphur, are certain indications of volcanic activity. *St Mary,* contiguous to St Michael, is a small island, with a fertile soil, which produces wheat in such abundance as to afford a considerable exportation.

Tercera,—is smaller than St Michael, abounds in grain and cattle; Angra, which is the chief town and harbour, is the residence of the governor; the population is estimated at 50,000, and it exhibits fewer marks of volcanic agency than the other islands of the group. The wines of Tercera are considered of an inferior quality, and the fruits raised are not more than sufficient for the consumption of the inhabitants.

Fayal,—abounds with all kinds of fresh provisions, and on this account it is much frequented by ships navigating the Atlantic. Villa de Horta, the chief town, contains numerous churches, and several monasteries. The bay is spacious and commodious, and, excepting with south-east winds, is reckoned a safe roadstead.

Pico, or *the Peak,*—is a remarkable island, composed of a huge conical mountain, which rears its head to the immense elevation of 7000 feet, or nearly a mile and a half. The lower regions of the mountain are highly cultivated, and richly clothed with vineyards and orange plantations; and 5000 pipes of wine, of the nature of Madeira, are annually exported; and as it is shipped at Fayal, it is known by the name of Fayal wine.

St George and Graciosa,—are two small islands between Tercera and Fayal. Graciosa is chiefly remarkable for its fine scenery. St George is fertile in corn and fruits, and abounds in cattle; but in May 1808 it was visited with a most destructive volcanic eruption. This awful disaster commenced on the 1st of May, and, with some intermissions, continued till the 5th of June. The island was convulsed with

Azote.

earthquakes; vapour and flames were emitted, and enormous quantities of ashes and lava were ejected; overwhelming in their progress vineyards, corn-fields, farm-houses, and cattle; and many of the inhabitants, scalded with the hot steam, expired on the spot.

Corvo and Flores,—which complete the group of nine islands, lie at a considerable distance from the rest of the Azores. Some of the numerous bays of the latter island afford safe and commodious shelter to ships. Flores has been long celebrated for the excellence of its poultry; and its herds of a small kind of cattle are abundant.

AZOTE, or azotic gas, from the Greek, and signifying *destructive of life,* because it is unfit for the purpose of respiration when it is in a state of purity, is one of the constituents of the air of the atmosphere, in the proportion of 79 parts to 21 of oxygen gas. In the older books on chemistry, it is denominated *phlogisticated air*; and it is sometimes called *nitrogen,* because it is the base of nitrous gas and nitrous acid. See CHEMISTRY.

Azure.

AZURE, was formerly applied to the fine powder prepared from *lapis lazuli* for painting, and is now restricted to the preparation of the oxide of cobalt, combined with vitrifiable matters, in which state it is employed to colour glass and pottery-ware. See CHEMISTRY.

Baal || Babel.

Babelmandel || Babylon.

B.

B is the second letter of the English alphabet and of most others, is arranged with the letters called labial, because the lips are the chief organs in its pronunciation, and having a close affinity with P and V, the other labial letters, is substituted occasionally for both in ancient languages.

Among the Greeks and Hebrews the letter B was employed as a numeral, and denoted 2. When used as a Roman numeral, B signified 300, and with a line above it 3000. The letter B is frequently employed as an abbreviation, as, B.A. bachelor of arts; B.L. bachelor of laws; B.D. bachelor of divinity; and B.F. prefixed to decrees of the Roman senate, denotes *bonum factum*.

BAAL, or BEL, or BELUS, from the Hebrew, and signifying *lord* or *ruler*, was the god or chief object of worship among the Chaldeans, Phœnicians, and other eastern nations. Under this denomination the sun was worshipped; but it seems to have been extended to all the heavenly bodies, or, according to the language of sacred Scripture, *all the host of heaven;* and the temples and altars consecrated to this idolatrous worship were erected in high places. Perpetual fire was kept burning in them, which seems to have been intended as an expression of the permanency and uniformity of the heat of the sun, one of the chief objects of adoration. 2 Kings, chap. 23.

BABEL, a tower which was undertaken by the descendants of Noah; but their object was defeated by the miraculous introduction of the confusion of languages among those who were engaged in its execution. This tower was built in the plain of Shinar, and near the place where ancient Babylon afterwards stood. It was constructed of burnt bricks, cemented with slime or mud, instead of mortar, and the period when the undertaking commenced is variously stated at 105 years, 396 years, or 525 years after the flood. The dimensions of this famous tower, as they have been estimated by historians, are not less various. While some have ascribed to it the incredible height of four and even twelve miles, others have reduced it to about 700 feet; and a traveller, who examined its remains in 1779, asserts that its altitude is not less than 160 feet, and it appears like one uniform mass of earth.

Much speculation has been employed in discovering the object of this stupendous undertaking. From the scriptural expression of building a *tower, whose top may reach to heaven*, it has been inferred that the design of mankind in uniting their ingenuity and labour in this work, was literally to enable them to climb to heaven; but according to other opinions, it was intended as a place of retreat for safety, in case of a second deluge; or a monument or temple in honour of the sun, to whose influence the diminution of the waters of the flood, and the drying of the earth, was ascribed; or as a conspicous land-mark to direct their steps to their native city, after they spread over the country as their numbers increased. But it is quite obvious that all this is vague conjecture.

BABELMANDEL, or BABELMANDEB, a cape and straits at the entrance of the Red sea from the Indian ocean, sometimes called the *Straits of Mocha.* The breadth of the straits, by the latest observations, is not more than 15 miles. They are divided by the low, flat island of Perim, or Babelmandel. The cape is in N. Lat. 12° 40′, and E. Long. 43° 33′.

BABOON, the trivial name of a species of *simia.* See MAMMALIA.

BABYLON, a celebrated name in ancient history, and in the sacred Scriptures, is applied to a magnificent city, a powerful empire, or an extensive region. The name, signifying *confusion*, arose from the events recorded in Gen. ix. 1—9; for the city included the tower which the children of men had projected, and had begun to build, till their enterprise was frustrated by the confusion of their language.

City of Babylon.—Babylon was built in the vast plain interposed between the Euphrates and the Tigris. A branch of the former divided its area into two equal parts, which together formed an exact square, with sides 15 miles in length. The whole of this vast space was fortified by a stupendous wall 87 feet thick, and 350 high, which was encompassed by a ditch, brimful of water, of a corresponding magnitude, and surmounted at regular intervals by numerous turrets. Through these walls it communicated with the surrounding country by means of 100 brazen gates. The streets, in parallel lines, extended from gate to gate, and intersecting each other at right angles, divided the whole expanse into 676 squares, around which were built the houses, exhibiting ornamented fronts, and rising three or four stories in height. The intermediate spaces were employed as gardens, court-yards, and other accommodations. The river was lined with a noble quay, and crossed by a magnificent bridge; and for a defence against its annual inundations, prodigious banks, constructed with great art and infinite labour, increased its capacity; expansive artificial lakes drained off its superabundant waters, or broad and deep canals turned its streams into the Tigris. On the banks of the river, close by the bridge, stood the old and the new palaces; and in the vicinity of the first the temple of Belus,—the unfinished tower of Babel,—four furlongs in compass, and lifting its head to the clouds by eight steep stories, each exhibiting the appearance of a distinct tower. This appearance was occasioned by a passage which winded around from the ground to the summit, where was an excellent observatory. Edifices for the worship of Belus, and other idols, were ranged around

Babylon. its base. The hanging gardens, enumerated among the wonders of Babylon, were sustained by stupendous arches, and rose by regular recession, in a series of terraces, the respective areas of which were 400 feet square. A course of large stones, a layer of reeds and bitumen, and a covering of lead imposed upon the arches, prepared these squares for a deep bed of rich vegetable mould. In the front of the terraces, delightful apartments, commanding an extensive view, were formed; and water, raised from the river by machinery, distributed refreshing moisture to the richest variety of herbs, fruits, and flowers.

Building of Babylon.—The description of Babylon, seems to partake of the extravagance of an eastern tale, fitted indeed to regale the imagination, but to have little claim to the sobriety of historical truth. The erroneous estimate of ancient measures may have led to exaggeration; but, after every allowance, Babylon, in its ancient state, exhibits a grandeur not to be contemplated without astonishment. Dr Gillies takes the stadium at a length which circumscribes the city, and diminishes its walls; yet, even according to him, Babylon was eight times larger than London and its suburbs. The authority of Scripture also supports both the antiquity and the greatness of this celebrated city. The trespass, so fatal to Achan, and so calamitous to Israel, originated in his desire for a *goodly Babylonish garment*, Joshua vii. 21. Its beauty, its excellency, its abundant treasures, and its gates of brass, are alluded to in scriptural prophecy. History ascribes to Semiramis, queen and successor of Ninus, the honour of planing and nearly completing the building of Babylon. It is even reported. that she had two millions of men employed in the accomplishment of her magnificent enterprize. But Nebuchadnezzar, who is so often mentioned in the Scriptures, enriched it with splendid embellishments. To gratify his wife, a princess of Media, who admired the mountainous scenery of her native country, he caused the gardens already described to be constructed. Intoxicated with pride, he said, in the spirit of imperious arrogance, as he surveyed his works—Is not this great Babylon, which I have builded for the house of my kingdom, by the might and the honour of my majesty? and was thenceforth humbled to the lowest state of abasement, and the city in which he boasted was also near its fall.

Babylon taken.—In the succeeding reign it was invested by Cyrus, the conqueror of Asia. After a blockade of two years, he obtained possession of it, amid the revels of a general festival. Having turned the course of the river by means of its canals, he so completely drained it of its waters, that his army marched along the channel into the heart of the city, and easily became its masters. From this period, it sunk into comparative insignificance. Darius demolished its walls, with their gates of brass, and massacred its inhabitants in multitudes. Alexander the Great was ambitious to restore it again to the rank of an imperial city, and had commenced his repairs, when death put an end to his magnificent designs. Declining rapidly from this period, Babylon soon became a heap of ruins.

Ruins.—This great city, in the time of Strabo, had become a desert. Jerome, who flourished in the fourth century, tells us, that the royal hunts were in Babylon, and wild beasts of every kind confined within the circuit of its walls, and that the whole space was full of desolation. A traveller, in 1574, could discern great masses of ruins, but durst not approach them for fear of the wild creatures which they harboured: And Hanway tells us, in his travels, that these ruins are now so much effaced as to have left few vestiges to point out the place where they once rose in regular proportion, in all the strength and beauty of architecture. Mr Rich, as stated in his Memoir published in 1815, proceeding upon the suggestions of Major Rennel, examined the banks of the Euphrates, northward of the village of Hellah; and amid many mounds of smaller dimensions, he found one 1100 yards long, and 800 broad. Farther on he found a mass 700 yards square, named by the natives, *kasr*, or palace. A mile beyond this he came to an irregular object, varying in length from 136 to 200 feet, and rising to 140 in height. This is denominated the *Mujelibe*, from the top of which Mr Rich surveyed the surrounding plain, but could observe no other large mass in this neighbourhood. But about six miles to the southwest of Hellah he found a heap of ruins of an oblong form, 762 yards in circumference. and rising in the manner of a cone to the height of 198 feet, called *Birs Nimrod*. These ruins are now used as quarries for the construction of other cities. This circumstance exposed their interior to the inquisitive observations of Mr Rich, which he found to be composed of burnt and unburnt bricks, of several sizes and various degrees of fineness, cemented together with mortar, bitumen, and chopped reeds and straw. In some places he found pieces of wall in an entire state, eight feet thick, ornamented with niches, and strengthened with pilasters. No certain conclusion can be drawn from the information contained in the memoir of Mr Rich, but he has promised to persevere in his investigations.

Let the candid reader now compare these details with the predictions of Isaiah and Jeremiah respecting Babylon. Let him consider that they were delivered when the kingdom of Judah was on the decline, and the empire of Babylon increasing in glory, in honour, and influence, and he must be astonished at the completeness of their accomplishment. He will observe with amazement how every purpose of the Lord hath been performed against her; how she has become heaps of ruin, a dwelling place of dragons. How Jehovah of Hosts hath swept her with the besom of destruction!

Empire of Babylon.—It seems probable that the famous Tower of Babel gave rise to the name of the oldest empire in the world. The astronomical tables sent by Alexander to Aristotle, carry back its existence 2234 years before the birth of Christ. But shadows, doubts, and darkness, rest upon it, till the city of Babylon, 605 years before Christ, became, under Nebopolassar, the capital of his kingdom.

This potentate, otherwise named Nebuchadnezzar, was chief priest, and hereditary satrap, during the disgraceful reign of the effeminate Sardanapalus.

Having formed an alliance with Cyaxares, the Mede, he obtained the sovereign power through his assistance; and as Nineveh had been destroyed by fire, he transferred the government to Babylon.

Nebuchadnezzar of the Scriptures, his son, was first the associate, and then the successor of his father. He had a warlike genius, gained many victories, extended the empire by conquest, and reduced refractory provinces to obedience. From the plunder of vanquished countries he filled his capital with disgraceful riches, and, among the rest, with the sacred vessels of Solomon's temple. He was succeeded by Evil-Merodoch, a weak voluptuous prince. After some usurpations, Nabonadius, the Belshazzar of the Scriptures, and son to Nebuchadnezzar, succeeded to the throne. The reins of government were at first held by Notaris, his mother, a woman of talent and enterprize. She was careful to finish the works which her husband had commenced, and was anxious to support the tottering throne. But its total overthrow was at hand. While Belshazzar the king made a great feast to a thousand of his lords, and drank wine before the thousand, Cyrus without the walls was exerting all his powers to obtain possession of the city, an enterprise which he accomplished, to the subversion of the Babylonian empire. The king was slain, and the kingdom was divided and given to the Medes and the Persians.

Country of Babylon.—The appellations, Babylon, Chaldea, and Assyria, are frequently used indiscriminately by historians. But Babylonia seems to have been an early and a general designation of the region around the celebrated tower of Babel. While the great city described above continued to be the metropolis, Babylonia comprehended all the countries which composed the empire. But the name properly belongs to the country called in scripture Aram beyond the River, a region which lies between the Euphrates and the Tigris. These great rivers rise among the mountains of Armenia, and, flowing in the same direction, recede and approach each other in their course, till they unite their streams, and fall by one channel into the Persian gulph.

The country inclosed in these natural boundaries slopes towards its rivers by so gradual a declivity that throughout its whole length it presents the appearance of two immense hanging gardens. By the industry of the inhabitants, canals of every size were cut from the higher to the lower river, rendering it a well watered garden; so that, in respect of fertility, it even far surpassed Egypt. "In the language of Herodotus and Strabo, quoted by Gillies, it restored with increase of a hundred, and three hundred fold, all the finest kinds of grain with which it was sown or planted. The leaves of wheat and barley were four fingers broad; the whole country was adorned with palm trees, which presented the triple offerings of bread, honey, and wine; fruits in the same season were succeeded by flowers, and the soft warm soil, strongly impregnated with nitre, required only a sprinkling of water to be converted in a few weeks from an arid waste into a green paradise." This country abounded in excellent materials for building; it afforded a viscous clay, which, when formed into bricks, became fit for use by merely hardening in the sun. Its bitumen, found every where, made a firm cement, and forest trees were floated down the rivers from the woods of Armenia.

Under such favourable circumstances, it need not be wondered at that Babylonia became the first theatre of civilization, that its inhabitants were so numerous, its cities so stupendous, its arts so manifold and perfect, its riches so immense, its commerce so great, or that it should still retain a commanding influence over the imagination.

BACCHANALIA, were festivals celebrated by the ancient Greeks in honour of Bacchus. Those who took an active part in the performance of these sacred rites assumed the character of Pan, Silenus, and the Satyrs, appeared in appropriate dresses, were crowned with garlands of vine leaves and ivy, and were accompanied with musical instruments, as drums, pipes, and rattles. These festive scenes were usually exhibited in the night; and the most extravagant licentiousness and grossest debauchery prevailed. The labours of oriental antiquaries have been much occupied in tracing the origin of the mysteries of Bacchus; and later writers seem to have adduced plausible reasons for supposing that the earliest institution of these rites took place in India.

BACCHARIS, or PLOUGHMAN'S SPIKENARD, a genus of plants belonging to the Syngenesia class.

BACCHUS, the god of wine, according to ancient mythology, was the son of Jupiter and Semele. Always represented in the bloom of youth, he wears a garland of ivy or vine leaves, he holds in his hand a *thyrsus*, or staff bound with ivy, and his chariot is drawn by tigers, or lions, accompanied by his preceptor Silenus, and a band of satyrs and bacchanals. The superstitious gratitude of ancient nations acknowledged Bacchus as the author of many essential benefits conferred on mankind. Agriculture, commerce, navigation, and even the constitution of human society, have been ascribed to this divinity. His history has been a fertile subject of learned discussion. While some think that Bacchus is to be considered as the same person with Moses, others suppose that he was Nimrod or Noah; and Sir William Jones contends that he was Ramah, the son of Cush. The same accomplished oriental scholar seems to be of opinion, that the Greeks derived their Dionysus, or Bacchus, or the incidents of his history, from India. In support of this opinion, he refers to a comparison of the poem entitled *Dionysiaca* of Nonnus, and the epic poem on the same subject called *Ramayan*, the production of one of the first Hindoo poets. Bryant's *Mythology*. *Asiatic Researches*, Vol. I.

BACHELOR, a term applied to an unmarried man. Under some of the ancient governments, bachelors were regarded as a kind of degraded citizens; they were the subjects of particular enactments, and they were deprived of certain privileges. By the laws of Lycurgus they were excluded from all offices of the state, whether of a civil or military nature, and they were even prohibited from being present at the public entertainments. Among the Romans, it was not unusual for the censors to impose arbitrary fines on old bachelors; and in the time of Augustus a law was passed, by which they could not receive a legacy, or succeed to an inheritance bequeathed to them by will, except from near relations. In Britain, a direct tax was imposed on bachelors in the time of William and Mary; and, at the present day, the servants of such persons are subjected to the payment of a higher duty.

BACHELORS, under the feudal institutions, were of an inferior order to the knights; and hence they were distinguished by the title of *knights*-bachelors. Such persons as held possessions too small to bring a sufficient number of retainers into the field to enable them to display their own banner or such as were under the command of knights, came under this denomination. Their rank was inferior to that of knights, but superior to that of esquires or gentlemen. The French expression *bas chevaliers* "inferior knights," seems to point to a plausible origin of the term.

BACHELORS denote such persons as have attained the first step in the literary honours conferred by universities, as bachelor of arts, bachelor of divinity. Four years attendance are required to be entitled to the degree of bachelor of arts at Oxford; three years more are necessary to obtain that of master of arts; and seven years more to become bachelor of divinity.

BACKGAMMON, an amusing game which is played by two persons with dice and a table, on which fifteen men, assigned to each player, are arranged in a particular manner. The success of the game, it is obvious, depends partly on chance, and partly on the skill of the player in the management of his men. See Games.

BACON, Roger, an English monk, who, by his extraordinary attainments in natural philosophy, outstripped the age in which he lived by several centuries, was born at Ilchester in Somersetshire, in 1214, studied first at Oxford, and afterwards in the university of Paris; and on his return to England in 1240, when he was in his twenty-sixth year, he assumed the monastic habit among the Franciscan order. Oxford became again the place of his residence; and while his investigations were directed to every department of physical science, the astonishment at his remarkable discoveries, excited by the ignorance of the times, brought down upon him the charge of necromancy or magic, and exposed him to severe persecution. He was prohibited from instructing youth, and then subjected to close confinement. During the short pontificate of Clement IV. which lasted only three years, the severity of his enemies had either relaxed or was suppressed by higher influence. But the exaltation of his successor to the papal throne was fatal to the enlightened philosopher. He was seized in France, thrown into prison, and spent ten tedious years in a dungeon. Having once more obtained his freedom, he returned to Oxford, and died in 1292, when he had reached the 78th year of his age.

Beside the predominant studies of the times, such as grammar, logic, and theology, in which he was highly conspicuous, his knowledge of various branches of natural philosophy, and particularly of optics, astronomy, and chemistry, has not failed to excite the admiration of the present age.

Bacon has been very generally allowed to be the inventor of gunpowder; but from certain ambiguous expressions in his works, it is alleged that he was not the actual inventor, but only that he was acquainted with the nature and effects of that remarkable compound. A new edition of his *Opus Majus*, or Great Work, which comprehends an abstract of his other treatises, was published in 1733; and, beside some other productions, his *Epistle on the Secret Operations of Nature and Art, and on the Futility of Magic*, all in Latin, has been often reprinted.

BACON, FRANCIS, Lord Verulam, and Viscount St Albans, the father of modern philosophy, was born at London on the 22d of January 1560-1. His early genius, and the rapidity with which his faculties were developed, promised a rich reward for the anxiety of parental instruction, and a splendid accession to the honours of his name. The discernment of Queen Elizabeth, who had frequent opportunities of seeing him during the time that his father was Lord Keeper of the Seals, was gratified by his acuteness and good sense. A reply to a very simple and common question put to him by that princess, while he was yet a boy, is recorded as an example of readiness of mind, which, independent of the delicate flattery, did not fail to call forth her commendation. Having asked him his age, he answered, that "he was just two years younger than her happy reign." This talent of negociating words to the best advantage, according to one of his own sagacious remarks, that they are "the counters of wise men, and the money of fools," found adequate reasons for exercise in the courts of Elizabeth and her vain-glorious successor. But its pruriency, and certain indications of a kindred vice, have cast a baneful shade over the character of the philosopher.

After some years study at Cambridge, Bacon was ushered into public life and the concerns of government, by accompanying Sir Amias Powlet, the English ambassador, to the court of France. That minister, fully sensible of his qualifications, entrusted him with an important commission to the queen, which he executed in the most satisfactory manner. He was now little more than seventeen years of age. The death of his father, which occurred soon after, was injurious to his advancement, and involved him in the usual difficulties of a younger son. He betook himself, in consequence, to the study of law, in which he made such advancement, that he was deemed worthy of being named, by Elizabeth, her learned counsel extraordinary, at the age of twenty-eight. The path of greatness, so earnestly eyed by his ambition, now lay fair before him; but he had to encounter the parsimony, and perhaps, too, the ingratitude of his sovereign, though he did not scruple to solicit her good graces by paying court to her favourite, the Earl of Essex. The influence of the Secretary Cecil, who was jealous of his talents, and disliked his attachment to that unfortunate nobleman, limited his success to the promise of a reversion of a valuable office, which did not become vacant for nearly twenty years. Bacon's subsequent desertion, and indeed zealous prosecution of the favourite, when his imprudence and high-mindedness had involved him in a fatal calamity, implied a baseness of feeling still more contemptible than the inveterate selfishness of soul which

Bacon. could find patience for so long a servitude of adulation and desire. Elizabeth herself, whether from a sense of dignity, which she knew well how to sustain, or from the remembrance of an affection sufficiently vivid to shed a kind of sympathetic tenderness over her heart, was offended at the pertinacity and bitterness of Bacon's maledictions. She took care not to reward these exertions, which subjected him, besides to the just indignation of the people, who were more cordially attached to Essex than they usually are to favourites.

On the death of Queen Elizabeth, about a year after his fate, and hastened, as has generally been imagined, by sorrow for the part which she had been constrained to act towards him, Bacon appears to have been among the first of the English courtiers who "hailed the rising sun." He had the prudential policy to offer his services to James, through the medium of all the Scottish noblemen and gentlemen to whom he could possibly procure access, before that ostentatious and conceited monarch had quitted his own country, to take possession of the throne that awaited him. The celerity and amount of his successive elevations repaid his assiduity, and very distinctly proved, that this most prolific eulogist and admirer had found a suitable merchant for his ware. There was almost a strife between them for some time which should exceed; the one in fulsomeness of flattery, the other in bountifulness of giving. The comparison, which is somewhat striking, terminates in favour of the former. Bacon's dedication "Of the Advancement of Learning," is, in reality, a masterpiece of panegyric. His loyalty discovers what his religion assured him was inscrutable,—the virtues and faculties of the king. Hence he expresses his wonder "at the largeness of his capacity, the faithfulness of his memory, the swiftness of his apprehension, the penetration of his judgment, and the facility and order of his elocution." These are but samples of the exuberant mass of Bacon's commendations, the climax of which is contained in an expression virtually, if not avowedly contrived, to carry the monarch's conceit into the regions of blasphemy. "I am well assured," says the pompous sycophant, "that this which I shall say is no amplification at all, but a positive and measured truth, which is, that there hath not been since Christ's time any king or temporal monarch which hath been so learned in all literature and erudition, divine and human!" The substantial and showy recompenses on James's part, were, in rotation, knighthood, the appointment to the king's learned counsel, the office of solicitor-general, a judgeship in the knight-marshal's court, the office of attorney-general, a seat in the privy council, the appointment of keeper of the great seal, the supreme office of lord chancellor, and the titles of Baron Verulam and Viscount St Albans. These last honours were conferred on him in 1619. His prosperity now began to ebb.

The parliament of 1621, most laudably intent on the examination and redress of certain grievances, preferred the serious accusation against Bacon of having taken bribes from suitors in the court of Chancery. Investigation demonstrated his guilt, which he had the humility to confess, but which he endeavoured, in a pitiful and very fallacious manner, to palliate or excuse. He threw himself at last on the mercy of his judges, the House of Peers; but their decision savoured more of strict justice than any "compunctious visitations." He was sentenced "to undergo a fine of forty thousand pounds; to be imprisoned in the Tower during the king's pleasure; to be for ever incapable of any office, place, or emolument in the commonwealth, and never to sit again in parliament, or come within the verge of the court."

The chief causes of Bacon's fall had some semblance of virtue, or at least indicated a generosity and amiableness of disposition, which serve rather to restrain than altogether to supersede censure, and in which, particularly at this distance of time, humanity is willing, though not indeed quite able, to conceal his delinquencies. Bacon had a liberal mind, which naturally sought a splendour and immensity of style proportioned to the magnitude of his intellect and the dignity of his rank, without possessing the requisite attention to the economies of life, and without exercising the no less requisite suspicion of the common retainers on greatness. The consequences were, an expenditure beyond his income, which seduced him into dishonourable compliances, and a habit of indulgence towards his dependents and retinue, which even connived at rapacity and extortion. A single anecdote illustrates his own conviction of the mischievous effect of this last failing. One day, during his trial, as he passed through a room where some of his servants were sitting, they got up to salute him; "Sit down, my masters," said the chancellor, "your rise hath been my fall!"

Bacon was sent to the Tower, but soon regained his liberty by the mercy of the king, who forgave the fine, and ultimately, as far as he could, remitted the censure passed on him, settling him besides in a pension of L.1800 a-year. He was now about sixty years of age, and in full possession of those powers of mind by which, in spite of his errors and disgrace, he has immortalized his name in the history of learning, and claims the admiration and gratitude of every succeeding generation. The remainder of his life was spent in retirement, and in all probability amid embarrassments, sufficient, in addition to the recollection of former greatness, to have broken down and destroyed the faculties of any ordinary character, but peculiarly calculated to give energy and interest to his ardent desire for posthumous renown. It was in this period that he either wrote or revised the chief of those works which have so largely contributed to the advancement of useful knowledge. His death took place on the 9th April 1626, in the sixty-sixth year of his age, and rather more than a year after the decease of James. It appears to have been immediately occasioned by over anxiety and exercise in prosecuting some experiments; but an infirm and declining state of health, had left little hope that his life could have been much prolonged.

Lord Bacon was of the middle stature, of a graceful and pleasing appearance, but somewhat delicate; his forehead was spacious and full, early impressed

Bacon.

with marks of age; he had a lively penetrating eye, dark hair and eyebrows; his features in general expressed sedateness and gravity, but he was capable of much animation, and could assume the most agreeable insinuating aspect and address; he excelled in conversation, by readiness of remark, copiousness of illustration, and inexhaustible and familiar acquaintance with the labours of former times, and a vivacity of imagination, which displayed the force and the originality of wit, without any of its coarseness or trifling. In private life he was temperate, modest, conciliating, and ready to oblige; attached to religion without being superstitious, he seems to have venerated the creed of his country as much from a conviction of its truth as the opinion of its utility. He married, when about forty, a daughter of Alderman Barnham, by whom he obtained a considerable fortune, but had no children. Foreigners held him in high repute during his lifetime, and probably, indeed, were more just to his merits than his countrymen. The Marquis D'Effiat, who brought over Henrietta Maria, wife to Charles the First, having paid a visit to Lord Bacon, found him sick in bed, with the curtains drawn. "You resemble the angels," said the polite stranger; "we hear those beings continually talked of, we believe them superior to mankind, and we never have the consolation to see them."

The writings of this illustrious man are numerous, and embrace a variety of subjects. His chief merit, as a philosopher, consists in the complete exposure of the errors of those systems by which the schools had for so long obstructed the course of science, and the substitution of a rational logic calculated to aid man in the acquisition of a true knowledge of nature. It is his highest praise that the rapid augmentation of human power, as effected by such knowledge in modern times, is clearly referable to the adoption of his principles, and that there is no instance in which any deviation from them has conducted to beneficial discovery. Attempts have been made of late to depreciate the value of his labours, and advantage has been taken of some of his inadvertencies and mistakes, particularly in natural history, to prove either the defectiveness of his laws or his own inconsistency with them. But these attempts have succeeded much better in shewing an invidious affectation and capriciousnees of mind, than in accomplishing the object they have in view. They are, at all events, refuted at every new step in the march of science. It has rarely happened, we may add, that any of those labourers whose names are associated with important discoveries, or valuable contributions to the stock of knowledge, have closed their lives without some tribute of veneration and gratitude to the genius and philosophy of Bacon.

The most convenient, and, on the whole, the best edition of Bacon's works, in Latin and English, was published at London in 1803, in ten volumes 8vo.

BACON, John, an English sculptor, who attained great celebrity as an artist, was born in Southwark in 1740, was placed as an apprentice to a porcelain manufactory at Lambeth, and was at first employed in painting ornamental pieces of china, but, from his skill and taste in modelling, he was afterwards entrusted with that department of the business. It is no less curious than instructive to perceive the dawn of rising genius, and to mark its progress towards its brighter day. The visits of Bacon to a neighbouring pottery to which some eminent sculptors occasionally sent models to be burnt, afforded him an opportunity of seeing and examining them, and from this slight incident those imitative powers, which reached so high a degree of improvement, were called into action. His first essay seems to have been a small figure of Peace, after the antique manner, which was executed in his 18th year; and five years afterwards, in 1763, he made the first attempt to work in marble, and at the same time invented an ingenious instrument which has since been approved and adopted by other artists, for determining with more precision the measurements and proportions. The only instructions which Bacon ever received in sculpture or modelling were derived from the Royal Academy, which was not instituted till 1768, when it is probable he had made considerable improvement in his art; and in the succeeding year he was honoured with the gold medal, the first premium for sculpture bestowed by that body.

The fame of Bacon fortunately procured for him royal patronage at an early period of his career. A bust of George III. one of his first works in sculpture, and intended for the university of Oxford, was so successfully executed, and afforded so favourable a specimen of his talents, that the king ordered a second to be presented to the university of Gottingen, and the queen ordered a third. His reputation as an artist was now established; and his future works bear ample testimony that the judgment of the public was not prematurely anticipated. Among the admired productions of his chissel may be enumerated, the monument to Mrs Draper, in the cathedral of Bristol; the statue of Judge Blackstone, in All Souls college, Oxford; the monument of Lord Rodney in Jamaica; of Dr Johnson and Mr Howard, in St Pauls, London; and, above all, the exquisite monument to the memory of Lord Chatham, in Westminster Abbey, which has been always regarded as one of the finest examples of the art.

An illness of two days duration closed his mortal career in 1799; and it is pleasing to record, that his eminence as an artist was equalled by the simplicity, integrity, and respectability of his character as a man.

Bactria.

BACTRIA, an ancient kingdom of Asia, supposed to be the modern Chorasan; has the river Oxus for its boundary on the north, and Asiatic Scythia on the east; is represented as an extensive, fruitful, and populous region; successively yielded to the victorious arms of the Assyrians, Cyrus, and Alexander the Great; was afterwards overpowered by the Huns, and finally subdued by the Scythians. In the later periods of its history, this territory has shared the fate of the surrounding country, but has never been able to recover its former independence. The Bactrians, of whom laboured accounts have been drawn up, to shew that they were a wise and valorous people, seem to have been addicted to the most cruel and most abominable vices; and if it be true that they trained dogs, expressively denominated *sepulchral dogs*, for the purpose of devouring the aged and infirm, who had become a burden on the community, the learning and civilization of such a people need not be alluded to.

BADAJOS, a strongly fortified frontier town, and capital of the province of Estremadura in Spain, is about five miles from the confines of Portugal. The ancient town occupied the site of the castle; and the numerous remains of Roman, Moorish, and Gothic structures, afford ample testimony of its former splendour. The modern city stands in a fine plain on the banks of the river Guadiana, over which a magnificent bridge of 28 arches is constructed. The streets are narrow and irregular; the population is estimated at 15,000; and the manufacture of hats gives occupation to a portion of the inhabitants. Badajos is the residence of the chief civil and military authorities of the province.

BADEN, a district of Switzerland, which is bounded on the north by the Rhine, and on the west by the river Aar and the canton of Berne; comprehends about 140 square miles; includes three towns and several villages, and numbers about 24,000 inhabitants. Baden abounds in corn and excellent fruits; and the banks of the Limat, which traverses the territory, are adorned with flourishing vineyards.

BADEN, the capital of the canton of the same name in Switzerland, is finely situated on the banks of the river Limat, and is still a place of frequent resort, on account of its hot springs, which retain all the celebrity which they enjoyed in the time of the Romans, by whom they were designated *Thermæ Helveticæ*. The waters are of a saline and sulphureous quality. A pillar erected in honour of the emperor Trajan, to commemorate the benefits which the country derived from the roads which he constructed; statues in alabaster; bronze coins; and medals of the emperors, in gold, silver, and copper, are enumerated among the remains of Roman antiquity which are yet in existence at Baden.

BADEN, a margravate in the circle of Swabia in Germany, occupies the eastern bank of the Rhine, and is bounded by the Black Forest on the east and by Switzerland on the south, is a populous and fruitful territory, finely diversified with extensive forests, cultivated fields, producing rich crops of corn, hemp, and flax, orchards which afford excellent fruits, and luxuriant vineyards. The meadows, watered by the Rhine, supply a profusion of herbage to horses and black cattle; the hogs, fed on chesnuts, afford bacon of a superior quality; and the mountainous pastures feed numerous herds of deer. Iron ore, marble and agates, which latter employs the industry of a portion of the inhabitants in cutting and polishing, are enumerated among the mineral productions.

The population is estimated at 200,000. Baden, Durlach, Stolhafen, and Rastadt, are the chief towns. Various manufactures, which are said to be greatly encouraged, are prosperous. The Lutheran form of religion is established, but other forms are tolerated.

BADEN, the capital of the margravate of the same name, stands at the foot of a mountain near the Black Forest, and is chiefly celebrated for its numerous hot springs and baths. The water, as it issues from the springs, is of the boiling temperature, and it is conveyed in pipes to almost every house in the town.

BADEN is also the name of another town in the archduchy of Austria, which is greatly resorted to by the inhabitants of Vienna and the surrounding country, on account of its baths, which are in much repute.

BADGER, the English name of a species of *ursus*, which is a native of Britain. See *Ursus*, under Mammalia.

BÆCKEA, a genus of plants belonging to the Octandria class.

BÆTYLIA, were stones of a black colour, which were regarded as objects of veneration and worship by some of the nations of antiquity. The traditionary history of some of these stones asserts, that they fell from heaven. Such is said to have been the origin of one which was preserved in the temple of Heliogabalus in Syria; and such, too, was the supposed origin of another in Phrygia, for the conveyance of which to the capital the Romans appointed a solemn embassy. The speculations and conjectures of modern times concerning meteoric stones, which are known by the most decisive testimony to have fallen from the clouds, have led to the probable supposition that the ancient stones were of a similar nature, and had a similar origin.

BAFFIN'S BAY, an extensive bay between Greenland and North America, and running north-east from cape Farewell in Greenland, from the sixth to the eighth degree of north latitude. It derives its name from William Baffin, a navigator who was employed in the year 1616 in the discovery of a passage through Davis straits.

BAGDAD, a city of Turkey in Asia, and capital of Irac Arabia and of the Pachalik of Bagdad, stands on the eastern bank of the Tigris, in north latitude 33° 20′, and E. long. 44° 20′; was founded by the caliph Almansor, in the 145th year of the Hegira, which corresponds with the 762d of the Christian era, and continued for more than 500 years to be the capital of the Saracen empire. In the year 1258 it fell into the hands of the Tartars, and continued in their possession till 1393, when it was taken by Tamerlane the Great. It was long the scene of contest between the Turks and Persians; but since it fell into the hands of the former in 1638, it has remained in their possession.

Bagdad is supposed to be about three miles in circuit; the walls are of brick, and the bastions are furnished with cannon; the houses, which are generally spacious, are built of brick, but mosques and other public edifices are constructed of hewn stone. The inhabitants, composed of Persians, Armenians, Turks, Arabs, and Jews, were computed by Tavernier, in 1652, at 15,000; but in 1779 they were estimated by an English traveller at 100,000.

The commercial prosperity of Bagdad has been subjected to numerous interruptions during the long period of its eventful history; but it is still to be regarded as the great emporium of the east, and the central communication for the exchange of the silks and cotton stuffs and spiceries of the Indies, for the productions of America and the merchandize of Europe.

BAGPIPE, a popular musical instrument in Ireland and Scotland; and, from the predilection for this instrument, it has been supposed to be peculiar to those countries. But it appears to have been familiar to the Greeks and Romans; for it is represented on the ancient sculptures and coins of those nations; and indeed it seems probable that it was not unknown among other nations at an earlier date, as it is now in use in most countries of Europe. This might be expected from the simplicity of its construction.

The peculiarity of the bagpipe, from which the name is derived, consists in collecting the air into a leathern bag, from which it is forcibly pressed into the pipes by the arm of the performer. The *chanter*, into which is inserted a reed for the production of the sounds by the action of the air from the bag, is perforated with holes like the German-flute, which are stopped with the fingers. The other parts of the instrument are three tubes or drones, which are also furnished with reeds. Two of the drones are in unison with D on the chanter, which corresponds with the lowest note of the German-flute. The third drone, which is the longest, is an octave lower. The tuning of the bagpipe is accomplished by lengthening or shortening the tubes, or drones, as may be required.

The Irish pipe is the softest of the different instruments of that description known in this country; it is always played with bellows; the chanter includes a range of ten or twelve notes; and an attempt has been made to improve it with the addition of keys to one of the drones by which intermediate chords are produced. The softness of the reeds and the length of the tubes are the characteristic differences of the Irish bagpipe.

In the Highland bagpipe the drones are shorter, and, by the peculiar construction of the reeds, a louder sound is produced. This pipe affords only eight or nine good notes. It requires a strong blast to play on this powerful instrument, and hence those who perform on it either walk or stand, that they may have the full and free use of their lungs.

The Scotch lowland bagpipe is described as somewhat different in its construction, both with regard to the notes and the intensity of the sounds, which is inferior to that of the Highland pipe; and in the small Scotch pipe the chenter is not more than eight inches in length.

From the nature and construction of the bagpipe, it is obvious that it must be very limited in its powers of execution as a musical instrument; and perhaps it arises less, even from the most perfect performance, than from the effects of early associations, that it is supposed to be peculiarly adapted to those wild irregular airs which form so pleasing a part of our native musical compositions; and may it not be in some degree ascribed to the same impressive effects, that its thrilling sounds have roused and invigorated the valour of our hardy mountaineers in the onset of battle, and inspiring their dauntless breasts with heroic ardour, have led them to deeds of glory and of victory in many a hard fought field?

BAHAMA ISLANDS, called by the Spaniards *Lucayos*, include a cluster of islands belonging to Great Britain, and extending from the 22d to the 28th degree of north latitude, and from the 70th to the 80th degree of west longitude. The number of this group of islands is supposed to be not less than 500, but twelve only are inhabited. New Providence, the largest, is about 30 miles long and ten miles broad. Nassau is the chief town, and the seat of government. Guanahani, as it was called by the Indians, is remarkable as being the first landing place of Columbus, after his adventurous voyage to the New World; it still retains the name of St Salvadore, which was imposed upon it by the discoverer of America, but is commonly called Cat Island, and contains more than 700 inhabitants. The cross was erected, and formal possession taken in the name of the Spanish king, but no permanent settlement was made. In the year 1629, some English colonists arrived in New Providence, and began to cultivate the soil; and from the favourable report of Captain Sayle, who had been driven among them, a colony was sent out by the English government in 1672. But the new settlement was so much disturbed and harassed by the Spanish pirates, that it was at last abandoned, when the islands became the resort of piratical plunderers, whose depredations called forth the interference of the British government for their suppression in 1721; and New Providence was resettled and strengthened with fortifications.

The chief produce of these islands, which is cultivated for exportation, is cotton, of which 1500 bags of two cwt. each, are stated, by Mr Edwards, to be the annual quantity shipped about the year 1789; but, in 1792, it had increased to more than a million pounds. The population of the Bahama islands, in 1773, amounted to 4293, one half of which nearly included the white inhabitants. But, by the official returns in 1812, it had increased to 16,718. Of this number, New Providence contains 6084, by a census in 1810, distributed into 1720 whites, 3400 slaves, and the rest free blacks and foreigners. The other islands, from the enumeration in 1812, have 10,634 inhabitants; of which 2150 are whites, nearly 8000 are slaves, and the rest are free blacks and persons of colour. The Bahamas are divided into nine parishes, all of which, excepting one, were vacant in 1812. Two presbyterian clergymen, one of whom is resident in New Providence, and the other in Turks islands, have each an annual stipend of more than L.100 Sterling from the colony; and three methodist missionaries are established in the islands, but no public provision is allowed for their support.

BAHAR, a province of Hindostan, which lies to the westward of Bengal, and is about 250 miles long and 200 miles broad. Patna is the capital. This province furnishes a large proportion of the saltpetre which is imported into England, as well as a great deal of the cotton stuffs which are brought to this country to be printed. Wheat, rice, and pease, are extensively cultivated; and opium, from the demand of the Chinese market for that drug, is one of the most valuable productions of the province.

BAHHREIN, or BAHREN, a cluster of islands on the western side of the Persian gulph, and near the coast of Arabia, which have been long celebrated. These islands were at one time subject to the Portuguese; were afterwards alternately in possession of the Persians and Arabians, but now acknowledge the authority of the scheik of Busheer, whose chief revenue arises from the duty on the pearl fishery and on dates. Bahhrein, which gives name to the whole group, is the chief town, and is situated in Aval, the largest island. The Arabic language is spoken by the inhabitants.

BAHIA, or ST SALVADORE, a sea-port town of Brazil, and the capital of a province of the same name, stands on the outside of All Saints bay, and is strongly defended by forts and batteries. The population is estimated at 100,000, of which 30,000 are whites, an equal number includes the people of colour, and the rest are negroes. The chief trade is with Lisbon and Oporto; European manufactures and merchandize are exchanged for cotton, sugar, and coffee, various woods, gums, and balsams. Bahia is the residence of the governor-general, and the see of an archbishop; and the cathedral is a magnificent structure of European marble. N. Lat. 12° 30. E. Long. 39°.

BAIÆ, an ancient village, between Cape Misenum and Puteoli, in Campania in Italy, which the classical scholar will recognize as a favourite retreat of the Romans, to which they were attracted by the mildness of the climate, the beauty of the scenery, and the luxurious enjoyment of its warm baths, from the bustle and business of the crowded capital. Becoming a place of fashionable resort, the limited spot which it occupied was enlarged by encroachments on the sea, and by erecting, at great labour and expence, the most formidable bulwarks to protect the habitations from the fury of the waves. From a retired village it grew into a large city, which, even in its ruins, presents striking proofs of its former magnificence. The irruption of the Goths into Italy was fatal to Baiæ: from that period it declined; and what the destructive bands of the barbarians spared was finally destroyed by the resistless violence of earthquakes and inundations.

BAJAZET I. sultan of the Turks, and celebrated for his warlike achievements, was the son of Amurath I. whom he succeeded in 1389, and holds a conspicuous place in history from the severity by which he was treated by his conqueror Tamerlane, who, it is said, exposed his vanquished enemy in an iron cage. But this story is variously detailed. In a dreadful conflict, in which more than 300,000 men are said to have fallen, Bajazet was taken prisoner; and having been conducted to the tent of the Tartar prince, he was thus addressed by the conqueror: "Alas," said the emperor, "the decree of fate is now accomplished by your own fault; it is the web which you have woven, the thorns of the tree which yourself have planted. I wished to spare, and even to assist the champion of the Moslems; you braved our threats, you despised our friendship; you forced us to enter your kingdom with our invincible armies. Behold the event. I am not ignorant of the fate which you reserved for myself and my troops. But I disdain to retaliate; your life and honour are secure, and I shall express my gratitude to God by my clemency to man." But this generous declaration, connected with what followed, is alleged to be somewhat tainted with the haughtiness of conquest. Bajazet was invited to the feast of victory; the Mogul emperor placed a crown on his head and a sceptre in his hand, and gave him a solemn assurance of restoring him to the throne of his ancestors. The death of the captive in 1403, about nine months after his defeat, precluded his enjoyment of the power and honours which were conferred on his son, whom Tamerlane set at liberty, with many rich presents, and put in possession of the kingdom of Anatolia.

The story of the iron cage is deduced from a different relation of what passed between the Mogul emperor and his royal captive. The generous intentions of Tamerlane were, in some degree, frustrated by the unseasonable arrogance of Bajazet himself; the complaints of his enemies, by no means frivolous or groundless, made a strong impression on the mind of the conqueror, who betrayed a design of leading his prisoner in triumph to Samarcand; an attempt to facilitate his escape by digging a mine under his tent, seemed to justify a harsher restraint; and in his rapid movements, an iron cage on a waggon, it is supposed, might be invented, not as a wanton insult, but as a rigorous precaution. Bajazet sunk under the trial; and, in a paroxysm of despair, it is said, dashed out his brains against the bars of his prison; and thus his premature death might, without injustice, be ascribed to the severity of Tamerlane. But the conqueror warred not with the dead; a tear and a sepulchre were all that he could bestow on a captive whom the hand of death had delivered from his power. The body was conveyed, with all the magnificence and pomp of royalty to Boursa, and with great solemnity consigned to the mausoleum which he had erected in the days of his prosperity and power. Gibbon's *Roman History*.

BAIKAL, a lake of Siberia, extending from the 51st to the 55th degree of north latitude, about 300 miles in length, varying in breadth from 15 to 50 miles, and in some places exceeding 3000 fathoms in depth, and, from some superstitious veneration attached to it by the natives who inhabit its shores, is dignified with the appellation of *holy lake*. The surrounding scenery exhibits many grand and picturesque features, from the rugged aspect and great elevation of the mountains, many of which are richly clothed with waving woods. The waters of the lake are so limpid as to permit objects to be distinctly seen at the depth of 50 feet; several large rivers discharge their waters into the Baikal, but it has only one known outlet. A liquid naphtha is thrown up on the surface in some places, and is collected for burning in lamps; and the shores abound with mineral springs, some of which approach to the boiling temperature. Lake Baikal contains numerous islands; one of which, near its northern shore, is of considerable extent, and is inhabited; and large herds of cattle are reared and fattened on its excellent pastures. Storms and sudden squalls are frequent; and the short summer of this severe climate rarely passes off without nightly frosts. The snow begins to fall in August; the lake is frozen over about the end of December, and the ice melts in the beginning of May.

The sandy shores and contiguous forests of the Baikal abound with some of the rarer vegetable productions of elevated regions. Of the plants enumerated by Pallas as indigenous to its shores, may be mentioned *dracocephalum nutans*, *lycopsis vesicaria*, *triticum litorale*, called by the natives, "wild barley," which covers the shores like a cultivated crop; *polygonum sericeum*, a beautiful species of knotgrass; and in the forests and higher grounds, *lonicera cerulea, linnæa borealis, rubus arcticus, ledum palustre*, and *pyrola uniflora*. The waters of this lake abound with fishes, among which are noticed a fish resembling the herring, which is called *omul* by the natives, and is caught in such quantities that it is a source of extensive employment and great profit; several species of the genus *salmo*, carp, tench, sturgeon, and what is singular, the seal is also a native, from which it is inferred, with some degree of probability, that the lake had once a communication with the ocean. The hunting of these animals, of which it is said 2000 are annually taken, begins in April, and their skins furnish a valuable commodity to commerce and the arts.

The fisheries on this lake are of great value and importance; and a considerable trade is carried on with the northern regions of China, by navigating its waters in the summer, and by travelling over the ice in winter. But the navigation is often attended with great danger from sunken rocks in the shallower parts of the lake, and from tremendous hurricanes, which are equally sudden and severe. The inequality of the ice, the unfrozen parts of the waters, and the furious blasts from the mountains, render the passage in winter not less insecure and hazardous.

BAIKAL MOUNTAINS, a lofty ridge, which runs nearly parallel to the lake of the same name, some of which rise to such an elevation as to be covered with perpetual snow; some are clothed with extensive forests, and others present a rugged and sterile aspect. The Baikal mountains are composed partly of primitive, and partly of secondary rocks. Granite, and some of its accompanying strata, occupy the higher regions, from some of which large plates of mica, better known by the name of Muscovy glass, is dug out in considerable quantity, and is employed as a substitute for glass in some parts of the Russian empire. In the lower regions, coal, native sulphur, and some metallic ores are common.

BAIL, a law term derived from the French, and signifying to *deliver up*, because the person bailed is delivered into the hands of the person who is surety for his appearance on being called before a court. Bail is taken, either in court, by sheriffs or other magistrates, and by justices of the peace. *Common* bail is taken in cases of small importance, and seems to be rather matter of form; but *special* bail, or substantial sureties, are required in actions to the amount of L.10 and upwards. The law declares that *excessive* bail, or to a greater amount than the case demands, is not to be insisted on. In *civil* cases every defendant may be bailed; but in *criminal* matters no bail is permitted on an accusation of treason, of murder, of manslaughter, when the indictment is found; of felony, if the person charged have broken prison, or be taken in the fact; of arson, or wilful fire-raising; of being outlaws; of having abjured the realm. But bail must be admitted, when sufficient surety is offered, for persons of good fame when charged under suspicion of manslaughter, for persons charged with petit larceny, and for persons accessary to felony; and the court of King's Bench, or any of its judges in vacation time, may bail for every kind of crime. Blackstone's *Commentaries*.

BAILIFF, in the early periods of English history, was an officer appointed for the administration of justice within a certain district, and seems to have possessed authority in some degree analogous to the power of the present sheriffs; but from the suppression of some courts, and the changes in others, the name is generally limited to officers of a very inferior rank, or such as serve writs, execute summons, &c. within their liberties and hundreds. Sometimes, even in the present day, the term bailiff is applied to persons of respectability, as the bailiff of Dover castle; and the magistrates of some towns still retain the same appellation. Sheriff's bailiffs are either bailiffs of hundreds or special bailiffs. Bailiffs of hundreds are nominated by sheriffs to collect fines, summon juries, attend the courts of assize and quarter-sessions, and execute writs in their several hundreds; but in the execution of some parts of their duty *special* bailiffs, who are more skillful and more practised, are conjoined with them. Bailiffs of *liberties* are appointed by the lord within his liberty.

BAILIFF, WATER, is an officer in seaport towns in England, who searches ships, collects anchorage duties, and arrests persons for debt on the water.

BAILLY, JEAN SYLVAIN, an eminent French astronomer, was descended from a family which for several generations had been distinguished for painting, and was born at Paris in September 1736. Destined to the same profession, he had made some progress in the art, but a passion for literature and science predominated in his mind, and his early acquaintance with the celebrated geometer La Caille decided his choice, and directed his studies to the higher departments of physical knowledge. The calculation of the orbit of the comet which appeared in 1759 is recorded as the first of his labours in astronomical investigations, to which so large a portion of his time and talents was afterwards devoted. The theory of the satellites of Jupiter, and the practical use of the observations of their eclipses in the discovery of the longitude, long engaged the attention of Bailly, and brought him forward as a powerful competitor for prize questions with some of the most distinguished philosophers of his country.

The reputation of Bailly rose high on the publication of the first volume of his History of Astronomy, which appeared in 1775; and became still more conspicuous for profound research, comprehensive views, and indefatigable industry, when the fourth volume of that great undertaking was presented to the public in 1782. Beside this work, which is peculiarly distinguished by animated description, luminous narrative, and interesting detail, he was the author of numerous memoirs connected with astronomy. But his labours were not confined to these sublime investigations. His "Letters on the Origin of the Sciences, and of the People of Asia," "On the Atlantis of Plato," and "On the Ancient History of Asia," and the "Eloges," which he composed on Leibnitz, Charles V. Corneille, La Caille and others, afford incontestible proofs of great versatility of talent, powerful genius, and an accomplished scholar. He was elected secretary of the French academy in 1784; and he was the only example, from the time of Fontenelle, of the same person holding a seat in the three learned Parisian academies.

Hitherto we have contemplated this distinguished philosopher in the shades of retirement, and deeply engaged in the calm pursuits of science, employing successfully the energy of a vigorous mind in the profound researches of physical truth. Less fortunate in his political career, he encountered the dreadful storm of the French revolution, and fell a lamented victim to the savage fury of a relentless and sanguinary faction. He became an early and zealous promoter of that revolution, which, now that the consequences have been seen and felt, holds out an awful lesson to the leaders of the populace to repress rather than to encourage and excite a spirit of tumult and disorder, which, once roused, bursts forth with ungovernable fury, and involves all in general ruin. In the share which Bailly took in that memorable struggle, it is acknowledged, even by opposite parties, that he acted with integrity; but, at the same time, it is admitted, that he was influenced by misguided zeal, and dazzled with the prospect of an imaginary freedom, which the people, for whom he laboured, were not qualified either to appreciate or to enjoy.

In the assembly of the states-general, which met in 1789, he was deputy to the *tiers etat*, was afterwards chosen president, and held the same conspicuous station when the national assembly was constituted. He warmly supported all the measures of the popular party, rose high in favour with the people; and when the office of mayor of Paris was revived, he was appointed by acclamation, on the day after the memorable 14th of July 1789, when the Bastile was stormed and taken; but, in executing the duties of this high office, the salutary restraints which he was compelled to employ, in checking the unbridled fury of a lawless mob, deprived him of his popularity, and led to his resignation in November 1791.

Declining health obliged him to withdraw from those tumultuary scenes which were exhibited in the capital, and to seek retirement and quiet in other parts of France. In the peaceful retreat which he had chosen, he resumed his literary labours, and was engaged in drawing up memoirs of the astonishing events which he had witnessed, and in some of which he had acted so conspicuous a part. But the period of proscription approached; he was denounced as an enemy to the republic, arraigned before a sanguinary tribunal, and condemned to death on the 10th November 1793; and on the succeeding day he was executed near the spot where, under his authority as mayor, he had ordered the soldiers to fire on the mob in July 1791. On the day of execution his sufferings seemed to be studiously protracted. He experienced none of that sympathy and compassion which are shewn even to the lowest criminal when he is about to expiate his offences with his life, but was treated by an incensed and barbarous populace with the most ignominious indignity and cruelty. Habited in the degrading garb of the red shirt, or badge of conspiracy, and with his hands tied behind his back, he was placed in a cart, and led to the place of execution in the midst of a torrent of rain; the populace as he passed, spit and threw mud upon him, and reviled him with the most opprobrious language; and when he was ascending the platform, a spectator near him insultingly exclaimed, "Bailly, you tremble." "Yes," he replied, "but not with fear." And thus unfortunately perished this venerable philosopher, in the 57th year of his age, deplored and regretted by the lovers of science and literature, which his genius and industry had so successfully illustrated and adorned.

BAILMENT, a law term, signifying a delivery of goods in trust, upon a contract expressed or implied, as when money or goods are delivered to a common carrier to convey from one place to another, he is bound by law either to carry them to the person to whom they are addressed, or to pay the amount of the value; or if a horse or goods be delivered to an innkeeper or his servants, he is bound to keep them safely and to restore them to his guest; or if a pawn-broker receive goods as a pledge for the repayment, on a fixed day, of money lent, he is under contract to return the goods when the pledger performs his part, by redeeming them in due time. Blackstone's *Commentaries*.

BAIRAM, the appellation of two festivals which are observed with great solemnity among the Mahometans. The word, which is Turkish, signifies a *feast*. The *Little* Bairam is held at the close of the fast Ramazan, begins with the first full moon in the following months, and is observed for three days in Constantinople and throughout Turkey, and in Persia for five or six days. The *Great* Bairam is a grand festival kept by the pilgrims at Mecca.

BAKER, Sir Richard, author of various works, but best known as the writer of the Chronicle of the Kings of England, was born in 1568, studied at Oxford, discharged the duties of high sheriff of Oxfordshire, and, through imprudence or misfortune, was reduced to such poverty that his latter days were passed in the Fleet prison, where he died in 1645, and where most of his literary labours were executed; but, with the exception of the *Chronicle of the Kings of England*, which has long obtained some degree of popularity, they have sunk into merited oblivion.

BAKER, Henry, an ingenious naturalist, was born in London about the beginning of the 18th century. Little is known of his early education, but it appears that he had for some time served as an apprentice to a bookseller, and having directed his attention to study the means of curing stammering, and to the methods of teaching the deaf and dumb, these pursuits became his professional employment in the future part of his life. What was his success in this laborious and useful occupation, is not recorded, but it seems to have been beneficial to himself in increasing his fortune.

By means of the microscope, Mr Baker employed much of his spare time in examining the habits and changes of animalcula; and with the assistance of the same instrument he studied the crystallization and configuration of saline substances. He had courted the muses in early life, and had made a considerable collection of objects in natural history; but his most valuable works are *The Microscope made easy*, and

Employment for the Microscope, which may be useful to those who are engaged in microscopical pursuits. Mr Baker died in 1774. His wife was the daughter of the celebrated satirical and political writer, Daniel Defoe.

BAKING is the art of preparing bread, or of reducing meal or flour of grain, or other substances, into bread. See BREAD.

BAKOU, or BAKU, a sea-port town on that part of the Caspian sea which is included in the territory of Persia, is strongly fortified, and enjoys a considerable trade in rock-salt, sulphur, naphtha, cotton, and saffron, which are produced in the surrounding country, and are exchanged for wine and silk stuffs. The approach to the harbour is incommoded with shallows, low islands, and sand-banks, which are common on the shores of the Caspian.

The everlasting fire and the naphtha springs in the neighbourhood, have been subjects of wonder to credulous travellers, some of whom have detailed exaggerated accounts of these natural appearances. In a dry and rocky soil, about ten miles from Bakou, a sulphureous or bituminous vapour issues from the earth, and when set fire to continues to burn for a long time. The votaries of superstition have taken advantage of this phenomenon, and have erected temples, in which the Indians perform certain religious ceremonies. A hollow cane is fixed in the ground near the altar in one of these temples, and a blue flame, which, it is said, has burned since the flood, and will continue to the end of the world, issues from its upper extremity. The soil is described as a mixture of coarse marl and sand. The chemical reader will be at no loss to perceive that this inflammable gas is produced by the decomposition of certain substances under the surface, and that it is probably the same with the carbonated hydrogen gas which is obtained from coal for the purpose of lighting streets and manufactories.

The naphtha springs in the neighbourhood of Bakou, are a copious source of revenue to the khan. The naphtha, of which the principal spring is in a small uninhabited island, is of various degrees of consistence; sometimes it is in a liquid form, when it boils over and runs in a continued stream, and sometimes solid and black like pitch. If accidentally kindled, the whole course of the current, as it proceeds to a great distance in the sea, appears in a flame. The naphtha is collected in reservoirs, and it is drawn off from one to another, for the purpose of purification; it is conveyed in vessels to different parts of Persia, and is employed by the poorer inhabitants both for light and heat. Springs of hot water are found in the same vicinity, and are employed both for bathing and drinking in the cure of various diseases. The naphtha, taken internally, and used as an external application, is also regarded as a sovereign remedy in a long list of disorders, though it may be justly doubted whether it penetrates instantaneously into the blood, as has been asserted.—Hanway's *Travels*.

BALA, a small town of Merionethshire, in North Wales, occupies a fine situation at the eastern extremity of Bala-pool, a lake about four miles long and 3-4th mile broad, and seems to be of great antiquity, from the traces of Roman camps observed in its vicinity. The lake which abounds with common trout, perch, and the gwyniad, a variety of trout peculiar to certain lakes in Britain and Switzerland, is traversed by the river Dee, whose current glides on unmixed with its waters. The inhabitants, estimated at nearly 15,000, are chiefly employed in the manufactures of woollen stuffs, gloves, and stockings, and have some trade in fruit, which is an object of culture in the neighbourhood. The distance from Welshpool is 26 miles, and 195 miles from London.

BALAAM, a prophet and diviner of the city of Pethor, whose intercourse with Balak, king of the Moabites, is recorded in the 22d and following chapter of the book of Numbers. This passage of Scripture has been a fertile subject of discussion among commentators, as whether Balaam should be regarded as a true prophet or a soothsayer; whether the incidents were real, or only an illusion; and whether it ought to be interpreted in a literal or allegorical sense. The words of St Peter support the literal meaning: "The dumb ass," says the apostle, "speaking with man's voice, forbade the madness of the prophet. 2 Peter ii. 16. and in this view it is to be regarded as a miraculous interposition of heaven. Calmet's *Dictionary*.

BALACLAVA, a town of the Crimea in Tartary. See CRIMEA.

BALÆNA, the whale, a genus of cetaceous fishes See CETOLOGY.

BALAGAT, or BALAGAUT, an extensive province of the Mogul empire in India, stretches along the elevated range of mountains called the Gauts; is bounded on the west by Guzerat, and by Visiapour on the south; and abounds with cotton, sugar, and other productions of the warmer regions of the earth.

BALAGAUT MOUNTAINS, a mountainous ridge, which runs nearly the whole length of the Indian peninsula, and divides Coromandel from the Malabar country. A remarkable diversity of climate is produced by this elevated region; and on different sides of it, opposite seasons prevail at the same time. One side enjoys the warm influence of summer, while the other is exposed to the severity of winter; and the tempest rages on one side, while all is calm and serene on the other.

BALANCE, an instrument for determining the weight of bodies, by comparing them with the known weight of another body. The construction of this instrument depends on the principle of the lever; and it must be referred to that kind of lever in which the distance between the fulcrum, or point of support, and the distance between the fulcrum and weight are the same; and therefore to bring the instrument to an equilibrium, or when it is exactly balanced, the power and weight must be the same. The balance is composed of a beam, suspended exactly in the middle; and from the extremities are hung two scales for the reception of the body to be weighed, and the weights with which it is to be compared, and the equality of these is known from the horizontal position of the beam. For the more precise determination of this position, a slender rod rises at right angles from the beam; and when this rod is exactly perpendicular, the beam is horizontal, and the weights in the scales are equal. In balances of great nicety and delicacy, the axis of the beam is a fine steel edge, supported by steel planes; the beam is a cylindrical rod; a double cone, the vertex forming the points from which the scales are suspended; or a frame of a rhomboidal form; and the horizontal position of the beam is ascertained by bringing the extremities of the arms exactly in a line with the zero points of two ivory scales, fixed within the frame which incloses balances of this kind.

For the accurate construction of a balance, it may be observed, that the points of suspension, or the points from which the scales are hung, and the centre of motion, ought to be in the same line;—the arms of the balance ought to be precisely of the same length;—the centre of gravity of the beam ought to be a little below the centre of motion;—and the bulk of the beam ought not to be greater than what is consistent with strength.

A balance, materially deficient in accuracy, whether by accident or design, is easily detected. If the arms be of unequal length, as in what is properly denominated *the deceitful balance*, the inequality may not be so great as to be perceptible to the eye; and when the scales are empty, the beam may remain in the horizontal position; but the difference may be such, that nine pounds in the scale attached to the longer arm may counterbalance ten pounds in the opposite scale; and thus the purchaser of a commodity, weighed with such a balance, may receive only nine instead of ten pounds. But by shifting the weights, and the body to be weighed, the fraud is instantly discovered; for then the equilibrium no longer remains; and indeed, wherever suspicion of inaccuracy exists, this simple test ought to be resorted to. See MECHANICS.

BALANUS, a species of shell-fish, belonging to the genus LEPAS, and to the order of multivalves. See CONCHOLOGY.

BALASORE HANDKERCHIEFS, from Balasore, a town of Hindostan, a cotton fabric in imitation of the Indian manufacture, in which the borders of the handkerchief are composed of coarser threads, distributed in different ways, to produce variety in the pattern; and with the same view coloured threads are sometimes employed. In other respects this manufacture is not different from that of plain muslin, excepting that the workman must observe some precautions in rolling up the cloth, in consequence of the inequality from the coarser yarn of the border.

BALBEC, a celebrated ancient city of Syria, stands at the foot of Anti-Libanus, and is said to be included within a wall four miles in circumference. The magnificence of the ancient edifices of this city has been minutely described by different travellers, and especially the Temple of the Sun, which, from its scattered fragments and mouldering remains, seems to have been one of the most splendid monuments of architectural skill and beauty which antiquity can boast of. Balbec was visited, in 1751, by Wood and Dawkins, the former of whom published an elegant work, consisting of drawings and descriptions, under the title of *Ruins of Balbec;* by Bruce and Volney at later periods; and to those writers the reader, who wishes for minute information, may be referred. The population, estimated at 5000 in 1751, had dwindled down to 1200 in 1784, occasioned, it is supposed, by the desolations of war and earthquakes. The remaining inhabitants are poor, and meanly accommodated in miserable hovels, presenting a striking contrast with the wonderful remains of the ancient structures. A little cotton, some maize, and fruits, are the only objects of their industry. Commerce, which once flourished, and manufactures, are now little known.

BALEARES INSULÆ, BALEARIC ISLANDS, the ancient name of Majorca and Minorca, in the Mediterranean, are supposed to have derived this name from the skill of the inhabitants in the use of the sling, and were invaded and conquered by the Romans. These islands, with some others, constituted a Roman province.

BALIOL, JOHN, King of Scotland, a name well known in the history of that kingdom, as the successful competitor with Robert Bruce for the throne, to which he was preferred by the decision of Edward of England, to whose arbitration the rival claims were submitted. Acknowledging Edward as his liege lord, Baliol was crowned in 1292, and formally professed himself a vassal of England. But the interference of the English monarch in the affairs of Scotland, and the indignities to which the king himself was subjected, roused him to resistance, and compelled him to throw off his allegiance. Edward invaded the kingdom with a powerful army, required from Baliol the most abject submission, and, having formally received his resignation of the Scottish crown, conveyed the degraded monarch in chains to London. Having obtained his liberty, Baliol retired to France, lived in the character of a private gentleman, and, after some fruitless attempts to recover the throne, he died in 1314, when he had reached the fifty-fifth year of his age.

BALISTES, a genus of fishes belonging to the order Branchiostegi. See ICHTHYOLOGY.

BALK, a province of Great Bukharia in Asia, and also the capital of the same province, which is supposed to have been the chief city of ancient Bactria, and a place of some note both in ancient and modern times. In 1221, when it fell into the hands of Zenghis Khan, who cruelly massacred the inhabitants, it was adorned with 1200 temples; and the number of baths appropriated to the use of strangers and foreign merchants amounted to 200, from which some estimate may be formed of its extent and population. Most of the houses are built of brick or stone; but some of the public edifices are constructed of marble from the mountains in the vicinity. Silk stuffs are manufactured in the city; and its central position renders it a convenient place for the trade between Bukharia and India.

BALLI, or LITTLE JAVA, one of the Sunda isles, about 70 miles long and 40 miles broad, is near the eastern extremity of Java; is supposed to include more than half a million of inhabitants, and abounds in rice, various fruits, and cotton, which is manufactured into different stuffs, and thus becomes a commercial commodity, which is exchanged for the porcelain of China.

BALLISTA, from the Greek, and signifying to *shoot* or *throw*, an ancient warlike machine, for discharging darts, the force of which, if the effects be not exaggerated, was irresistible.

BALLISTIC *pendulum*, an ingenious machine invented by Mr Robins, for determining the velocity of military projectiles, and consequently the force of gunpowder.

BALLOON, in its general meaning, signifies any spherical hollow body, as a round glass vessel used by chemists, a globe on the top of a pillar, and a kind of bomb constructed of paper or pasteboard and used in fire-works.

BALLOON, AIR. See AEROSTATION.

BALLOTA, WHITE HOREHOUND, a genus of plants belonging to the class Didynamia.

BALLYCASTLE, a sea-port town of the county of Antrim in Ireland, is chiefly known for the coaleries which have been long wrought in its neighbourhood, and is 30 miles distant from the town of Antrim.

BALLYMENA, a town of the county of Antrim in Ireland, which contains between 2000 and 3000 inhabitants, has a great weekly market for brown linens, horses, and cattle, and is 21 miles distant from Belfast and 93 miles from Dublin.

BALSAM, a fragrant, resinous, liquid substance, which exudes spontaneously, or flows by incision from certain plants. See MATERIA MEDICA.

BALTIC, an extensive inland sea in the north of Europe, whose waters wash the shores of Sweden, Russia, Denmark, Prussia, and Germany. The passage into the Baltic from the northern ocean lies between the 57th and 50th degrees of north latitude, in a direction to the north-east, where it is called Skagerak; then to the south, or the Cattegat; afterwards to the south-east, through the sound of Elsineur; and, last of all, it opens into a wide expanse to the north-west, and terminates in the gulfs of Bothnia and Finland; the first stretching eastward and approaching lake Ladoga, and the extremity of the last not far distant from the arctic circle. The length of the Baltic sea, from south west to north-east, exceeds 600 miles, and the breadth is from 70 to 80 miles. The depth is seldom more than 50 fathoms.

The Baltic is studded with numerous islands, of which the islands of Aland, Bornholm, Zealand, Rugen, Oeland, Gothland, are the principal; and many rivers, some of them of considerable magnitude, as the Dwina, the Oder, and the Vistula, discharge their waters into this sea. A constant current is observed flowing into the Baltic; and to counterbalance this accumulation of waters from the ocean, a subterraneous passage has been supposed to exist, though it is probable it may be effected by an under current, as is known to be the case at the straits of Gibraltar. The navigation of the Baltic is interrupted for several months annually, by the freezing of its waters along the shores, and in bays and gulfs; and in severe winters it is frozen over in some places, and admits of travelling in carriages.

Stretching along the shores of so many countries, the Baltic sea affords unlimited facilities to commercial enterprise. The ships of all European nations, as well as those of America, enter the ports of the Baltic; and in return for colonial produce and various manufactures, carry off grain, iron, hemp, flax, tallow, potashes, timber, and other commodities. In 1792, more than 9000 ships passed the sound; in 1802, the numbers exceeded 12,000; but it seems to vary from 8000 to 10,000, and of this number one-third belongs to Britain.

BALTIMORE, a county in the state of Maryland in North America, stretches along the bay of Chesapeake, which forms its boundary on the south-east, the river Patapsco is the southern boundary, and Pensylvania lies on the north; is traversed by several rivers and arms of the sea, which render commercial intercourse easy and commodious; and abounds with iron ore. The number of inhabitants is incorrectly stated, in some accounts, at little more than 25,000, when Baltimore, the most populous town, is said to contain 30,000, and Annapolis, the capital of the county, includes 2000.

BALTIMORE, the most populous town in the county of the same name in the United States of America, is regarded as the fourth town for magnitude in North America, and one of the most flourishing sea-ports in the States; is commodiously situated on the north side of the river Patapsco, not far from its influx into the Chesapeake, possesses one of the most spacious and secure harbours in America, and enjoys all the advantages of an extensive inland navigation from rivers and creeks, which admit vessels nearly 300 miles into the interior of the country. The population in 1791 was stated at 13,000; but about ten years afterwards, if the estimate be correct, it had increased to 30,000; a remarkable proof of the growing prosperity of the place. The town stands on two sides of a creek, over which are erected two bridges to facilitate the communication; and the increase is chiefly at a place called Fell's Point, to which large ships only, on account of the depth of water, can come. The trade is very considerable. The public buildings are fine structures; and ten churches, some of which are elegant edifices, belong to different denominations of Christians.

BAMBERG, the capital of a bishoprick of the same name in Germany, was ceded to Bavaria in the distribution of the German states during the French revolution; occupies a fine situation on the banks of the Rednitz and Maine; is distinguished by its spacious streets, the elegance of many of the public edifices, and the magnificence of the cathedral; and numbers about 19,000 inhabitants, who have a considerable trade in grain, fruits, wine, saffron, and liquorice, the copious productions of the fertile soil of the surrounding territory.

BAMBOROUGH, a village and castle on the coast of Northumberland, in England. See NORTHUMBERLAND.

BAMBOUK, a kingdom of western Africa, between the Senegal and Faleme rivers, is chiefly an arid and barren region; but on the banks of the river the soil is rich and productive. Iron and gold are said to be abundant; and rice, honey, and cotton are enumerated among the productions of Bambouk. The chief town, which is described as being very populous, has the same name, and the inhabitants are negroes.

BAMFF, a town and county of Scotland. See BANFF.

BAMIYAN, a city of Great Bukharia, in Tartary, occupies a central position in one of the branches of Mount Caucasus, is a place of great antiquity, and is held in high veneration by some of the eastern nations, as is abundantly obvious from its pompous designation in the original, signifying "most beautiful and excellent city." This remarkable city appears to have been cut out of the solid rock. Twelve thousand apartments or recesses formed in this manner, are spoken of by travellers. Some of these excavations are very spacious, and are supposed to have been intended for temples; some of them have been enriched with paintings, and others are adorned with sculptured work. Two figures, also cut out of the rock, of enormous magnitude, with a third, of smaller size, stand erect in niches, and are supposed to represent some of the divinities which are the objects of worship in eastern regions. Bamiyan, indeed, is regarded by some as the metropolis of the sect of Buddha; and hence it may not be improbable, that these extraordinary artificial excavations may have been intended for the residence of the priests and devotees attached to that system of religion.

Two miles distant from Bamiyan the ruins of an ancient city are yet visible, which, in the expressive language of the country, is called *Gulghulch*, or cries of woe, in consequence of the dreadful catastrophe which befel it in 1215, when it was taken by Zenghis khan, and the inhabitants of all descriptions, and even brute animals, were put to the sword. Bamiyan is ten days journey distant from Balk and eight from Gazna. *Asiatic Researches*, Vol. VI.

BAMPTON, a market town of Devonshire, is situated on a branch of the river Exe, contains about 1400 inhabitants, who are chiefly employed in the manufacture of serges, and is distant from Exeter 22 miles, and from London 167 miles.

BANANA TREE, a species of *musa* which is cultivated in the West Indies on account of its fruit, which is employed, as well as the plantain, as a substitute for bread.

BANBURY, a town of Oxfordshire in England, stands on the banks of the Cherwell, contains nearly 3000 inhabitants, many of whom are employed in the manufacture of plush and shag-cloth, and is 22 miles north from Oxford, and 75 north-west from London.

BANCA, an island in the Indian ocean, lies between Sumatra and Borneo, is separated from Sumatra by the straits of Banca, is about 100 miles long, and 30 broad, and is chiefly remarkable for its tin mines. The king of Banca, who resides in Palambang, in Sumatra, was formerly in alliance with the Dutch, who, in consideration of enabling him, with the assistance of their troops, to preserve his authority and independence, enjoyed an exclusive trade throughout his territories. The tin mines were discovered about the beginning of the 18th century, and it is said that three millions of pounds have been delivered annually to the Dutch, by whom great part of it was sent to the Chinese market, and some of it was occasionally imported into Holland; and from this trade it has been stated that they derived an annual revenue of L.150,000 Sterling.

BANDA ISLANDS, a cluster of islands in the Indian ocean, which are sometimes called Spice, or Nutmeg islands, in consequence of that valuable spice being the chief vegetable production.—See SPICE ISLANDS.

BANDANA, a term recently applied to a very considerable branch of the cotton manufacture, carried on principally in the vicinity of Glasgow, in imitation of a species of spotted silk handkerchiefs, originally brought from India under that name. The Indian Bandanas have generally one colour for the ground, such as red, blue, or orange, and were ornamented with small spots, sometimes white and sometimes tinged with yellow, which are disposed in groups similar to the specimen exhibited in Fig. 3. Plate 26.

History.—The first attempt to imitate the Indian Bandana handkerchiefs in this country appears to have been by tying small pieces of thread round those spaces of the cloth that were to be preserved from the colouring matter during the process of dyeing. But this method being both tedious and clumsy, was superseded by another, still in practice, upon blue grounds, which is, by printing a preventative paste upon the cloth, with blocks cut out to the pattern, before it is submitted to the operation of dyeing. As these methods were only practicable when the dyeing processes were few and simple, the former has been chiefly confined to silk fabrics, though the latter has been brought to very great perfection on blue cotton goods, from the facility of dyeing this colour in a cold vat.

But as neither these, nor any other expedients that have been yet discovered, are adequate to resist the processes of dyeing a permanently fixed red upon cotton grounds, this branch of the manufacture could never have been attempted with any prospect of success on any other principle than first dyeing the cloth, and afterwards extracting those portions of the colour that were destined to form the pattern. The circumstances which led to this discovery may be briefly stated as follows:

About the year 1794, after the oxygenated muriatic acid had been successfully applied to the art of bleaching, its property of destroying vegetable colours became pretty generally known, and gave rise to a new branch of the cotton manufacture, which was then known by the name of *clouding*. The processes by which this branch were conducted, were, first by compressing the several portions of the dyed yarn which were to retain the colour, between two slips of wood, by means of screws or some other expedient, and afterwards immersing the whole in the oxy-muriatic acid. Those parts, therefore, which were exposed to the action of the liquor were discharged, leaving the colours unimpaired which were secured between the slips of wood. About the same period, from the property of the oxy-muriatic acid, thickening oils, a kind of paste, was discovered, composed chiefly of the oil of turpentine, brought to a proper consistence for working with printing blocks, which effectually secured such colours as were covered with it from the action of this acid. This paste was printed upon cloth which was either wholly or partially fabricated from coloured yarns, and exposed to the action of the oxy-muriatic acid, by which all those parts of the colours were exhausted that were not secured by the paste.

Bandana.

From an intimate acquaintance with these processes, the idea of applying the screw-press to the discharging of Turkey-red handkerchiefs, now called Bandanas, was naturally suggested; and accordingly, during the years 1800 and 1801, Mr Robert Tweedie, Turkey-red dyer to Mr Monteith at Blantyre cotton-works, made several experiments of this kind, by means of two plates of copper, with a number of holes drilled through them corresponding to the pattern, by which the discharging liquor was transmitted through the cloth. These experiments were made on single handkerchiefs, folded into one eight part of their size, and strongly pressed between the plates with screws. After applying the liquor to the perforations in the plates, he found that the spaces opposite to the holes were discharged, while those that were secured by the pressure of the plates were completely preserved.

It was a considerable time before a mode of applying these experiments to the general trade was discovered. At length, in the year 1802, the same company at Blantyre found out a method of finishing whole pieces. As soon as it appeared likely to become a trade, two of these handkerchiefs were transmitted, through the collector of excise, to the commissioners in Edinburgh, for their opinion, whether such goods were subject to the existing duties, as the spots which made the cloth two colours were not "printed, dyed, or stained," the express words of the law. The answer of the commissioners was, as they considered it, "the goods being of two colours, by whatever means it was effected, rendered them liable to the duty." In consequence of this opinion, Messrs Henry Monteith, Bogle, and Company, entered their works, and have paid a duty of 3½d. per square yard from the very commencement of the business; and such is the amazing extent to which the manufacture of this single commodity has been carried, that the duties now paid by this company alone amount to upwards of L.20,000 Sterling annually.

The acquisition to the cotton manufacture of such a valuable branch of commerce, could not fail to attract general attention; in consequence of which several other Bandana works have since been established in Scotland on principles nearly similar. But as all the real improvements which have contributed to bring these works to their present state of perfection, have originated with the company already mentioned, they have still been able to maintain a decided superiority, as well in the preservation of their fabrics as in the beauty of their colours, and the delicacy and perfection with which their patterns are executed. For specimens of the latter, see Plate 26. Figs. 3 and 4. It is but justice to observe, that the present state of perfection at which these operations have arrived, is owing, in a very considerable degree, to the discoveries of Mr George Rodger, the manager of the works, who has held that situation for many years; and who, without the knowledge of the company, had turned his attention to the discharging of Turkey-red cloth, and brought it to no small degree of improvement as early as the year 1802.

Apparatus employed.—The principal part of the apparatus employed in discharging Bandana handkerchiefs, is the common screw-press, representations of which will be found in Figs. 1. and 2. Plate 26. The frame, and other parts that have much stress to bear, are now made of cast-iron. A, Fig 1. is a bed of cast-metal, on which rests the square-frame of cast-iron B, and to which is fastened the under plate *a*. C is another frame of cast-iron, to which the upper plate *c* is attached. A horizontal view of this plate, with the perforations through which the discharging liquor is transmitted, is given in Fig. 2. At *d* is a small rim round the plate, to prevent the liquor from running over its edges. The plates are sometimes made of copper, but more frequently of lead, hollowed out to suit any particular pattern.

Process for handkerchiefs.—When the piece of cloth which is to be discharged is sufficiently stretched, and folded into handkerchiefs, generally a dozen in each piece, it is placed in the press, between the two plates, and the upper plate is screwed down with the force of four or five men acting on a lever fourteen feet long. The liquor is then applied, and all the colour exposed to its action in passing through the plates, is extracted. After the discharge is completed, the cloth is immediately immersed in water, to prevent the fabric from being injured by the corroding quality of the liquor.

For running patterns.—Although the mode of folding the piece into squares, and finishing one of these pieces at each change of the press, be not very objectionable when applied to handkerchiefs, when an entire set of the pattern is completed at one operation, yet when the pattern is to be continued from one end of the piece to the other, as in garments, &c. this method will be found inadequate, as the figures which constitute the pattern would stand reversed in each fold. To obviate this, it is only necessary to lay twelve or fourteen pieces together after being properly stretched, and, commencing at one end, the process may be continued, progressively, till the whole be completed.

Power applied to the press.—It has been suggested, from the great force necessary to set one of these presses, by the present mode that the hydrostatic press is peculiarly adapted to this operation. This suggestion, however, has not yet been acted on in any of the Bandana works in the vicinity of Glasgow, nor we believe in any other place. From a very little consideration it will appear, that a uniform pressure must be maintained on the cloth during the whole operation of discharging the colours; otherwise, on the smallest relaxation of the press, the acid would insinuate itself between the edges of the plates at the perforations, and injure those parts of the colour which are intended to be preserved. From the imperfection of the valves, therefore, and the great pressure on the leather and other materials of which this apparatus is composed, the hydrostatic press has not yet been made sufficiently free from leakage to preserve the requisite uniformity of pressure for any length of time; and hence, till this objection can be obviated, it does not appear that the Bandana work can derive any advantage from this otherwise very useful and ingenious invention. The complicated apparatus necessary to give the screw a perpendicular or rather a circular motion, and the difficulty of ascertaining the precise moment when the apparatus must be discongaged from the power, to prevent the machinery from being broken in pieces, have likewise been urged against the application of the steam-engine to the Bandana press; so that until all these objections can be satisfactorily removed, the present mode of working these presses by manual labour appears to be the most eligible.

Chemical processes.—Before the discovery of the oxy-muriate of lime, or common bleachers salt, by Mr Tennant of Glasgow, the discharging liquor was prepared from the black oxide of manganese and the muriatic acid. The oxy-muriate of lime has now been adopted in all our Bandana manufactories. But it must be observed that the solution of this salt, in its combined state, acts only as a bleaching liquor, and requires to be disengaged from the lime, by means of another acid, before it can be effectually applied to the discharging of colours. Upon this consideration another method of extracting the Turkey-red colour from cloth has been recently invented, and a patent obtained for it by Messrs Thomson and Chippendale, printers in Lancashire. The principle on which their process proceeds is, to print a very strong acid, in the consistence of a paste, upon the dyed cloth, and afterwards exposing the whole piece to the action of a solution of oxy-muriate of lime, or the common bleaching liquor; and whenever the acid and solution unite, the colour is extracted.

Blue ground.—We have hitherto directed our attention to that species of Bandanas which is manufactured from the Turkey or Adrianople red; but as the blue grounds, though now forming a branch of calico printing, has an equal claim to Indian extraction, it may not be improper, under this head, to take some notice of the processes by which their manufacture is conducted. After the cloth has been sufficiently freed from impurities, and whitened, it is put through the calender, to give it a smooth and evenly surface. The preventative paste, formerly noticed, is now printed on with blocks, and when dry the piece is stretched and folded upon a kind of tenters, fixed in a square frame, leaving about an inch and half between each fold, in order to expose its surface equally to the colouring matter. The frame is suspended by a pulley, over a square blue vat, by means of which it may be raised and lowered during the process of dyeing. When the cloth has acquired the requisite shade, the paste is washed off, and the colour raised with a little oil of vitriol, (sulphuric acid,) diluted with water.

Preventative paste.—In a manufacture of this nature much diversity of opinion will, no doubt, exist, with respect to the best composition for these preventative pastes. The following recipe may afford some assistance to those who are inclined to make experiments of this kind.

Dissolve, in three quarts of water, one pound of the sulphate of copper, (blue vitriol,) to which add $1\frac{1}{2}$ oz. tallow, which has been previously melted and dropt into water; boil the mixture, thicken it with pipe-clay, and boil again for about ten minutes; then add a quart of gum liquor, made in the proportion of 2 lbs. gum Senegal to the gallon of water; let the whole boil again about ten minutes longer, and then take it off. When the liquor is cold, add four ounces measured, or one quarter of a pint of aquafortis, killed with copper. Some add to this a little verdigrease.

BANDITTI, derived from the Italian, and signifying *proscribed*, or *outlawed* persons, is an appellation originally applied to bands of robbers who infest the highways of Italy and Sicily, but has been extended to persons of similar character and pursuits in other countries, who act in opposition to the laws and regulations of civil society. In Sicily they have become so numerous and powerful, and have possessed themselves of such secure places for shelter and retreat round the eastern regions of Ætna, that no attempts yet made by the police of the country have succeeded in their suppression or extirpation. On the contrary, it has been deemed prudent policy in the government to connive at their depredations, and in some measure to consider them under its protection. When any of this society are disposed to retire from the mountains and forests, the Prince of Villa Franca admits them into his service, treats them with kindness and confidence, and finds them scrupulous and unshaken in their fidelity. As they are feared and respected in the country, travellers usually hire some of them as attendants in going from place to place, and in this way they are fully protected from insult and imposition in their intercourse with the natives.

BANDON BRIDGE, a town of the county of Cork, in Ireland, was begun about the beginning of the 17th century, by the first Earl of Cork, in a marshy spot on the banks of the Bandon, and has risen to such importance as to contain 12,000 inhabitants, who are engaged in woollen, linen, and cotton manufactures. The river Bandon is partly navigable, and discharges its waters in the harbour of Kinsale.

BANFF, a county in the north of Scotland, which has the Moray frith for its boundary on the north, Morayshire on the west, and Aberdeenshire on the east and south; is about 55 miles in length and 25 in breadth, and includes an area of more than 700 square miles.

General aspect.—Banffshire presents great inequality of surface. The inland parts of the county rise to a considerable elevation above the level of the sea. Cairngorum, the wide base of which is partly in Banff and partly in Morayshire, is 4050 feet high, and is famous for the smoky rock crystals which are designated by its name; two other mountains exceed 2000 feet in height; and Cullen-hill, at no great distance from the sea, is 1100 feet above its surface. While the summit of Cairngorum is covered with almost perpetual snow, the lower regions are clothed with extensive tracts of pine trees; and some of the less elevated mountains are richly adorned with waving woods to the very tops. Many of the vallies spread out into beautiful flats; the banks of the rivers are strikingly romantic; the sea-coast is chiefly bold and precipitous; and, on the whole, few places in Scotland can boast of a larger share of picturesque scenery.

Rivers.—The Spey, one of the noblest rivers of Scotland, forms part of the western boundary of the county, and some of its tributary streams have their sources in the elevated districts. The Deveron on

BANDANA MANUFACTURE

Fig. 1.

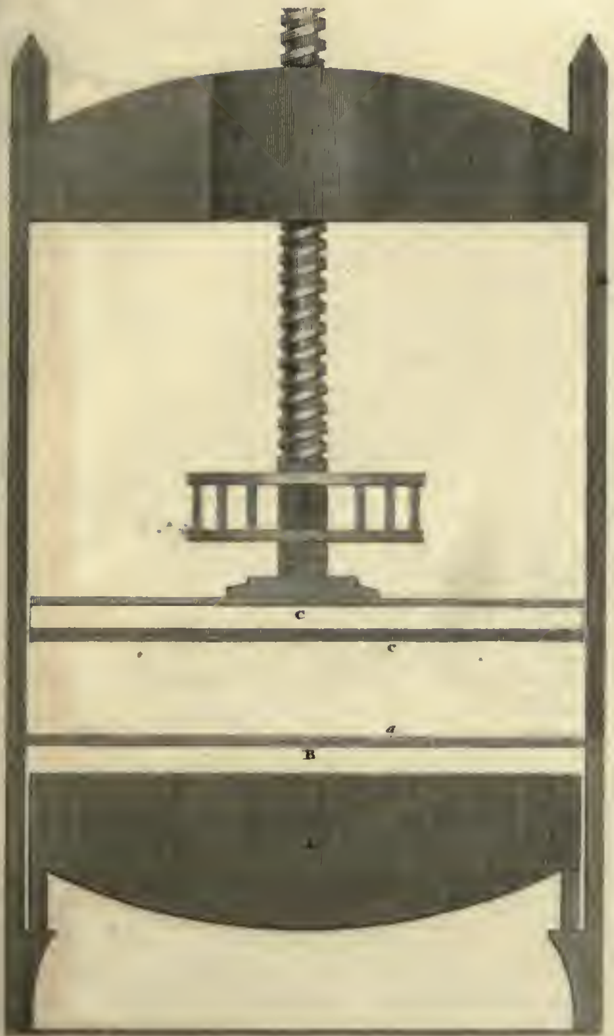


Fig. 2.

Fig. 3.

Fig. 4.

Drawn for the Encyclopaedia Edinensis by John Murphy.

Engraved by W. & D. Lizars Edinburgh.

the eastern border of the county, is enlarged in its course by the Boyne, the Isla, and other smaller rivers, traverses a fertile and varied district, and discharges its accumulated waters into the Moray frith at the town of Banff.

Natural history.—The climate of this county is rather moist, although it is not found to be unhealthy. A light sandy soil prevails in much of the flat grounds near the sea; but a deep clay is more predominant in the more elevated districts.

The mountains of Banffshire are chiefly composed of granite and other primitive rocks. The beautiful variety of that rock, called graphic granite, which, by the distribution of the quartz, one of its constituent parts, exhibits the appearance of Hebrew characters, has been long met with in detached blocks, from which the cabinets of collectors have been supplied with specimens; but the native repository has been lately discovered. The cavities of the same rock are no doubt the original sources of the cairngorum crystals, which are usually dug out of the alluvial soil at the bottom and on the sides of the mountains, and afford lucrative employment to many of the inhabitants. Limestone is abundant in many places, and marble is not a rare rock. What is called Portsoy marble, which is the serpentine of naturalists, a beautiful mineral substance, much employed for ornamental purposes, is disposed in strata nearly in a vertical position, and alternating with marble or limestone at the harbour of Portsoy, from which it derives its name. Sandstone, both red and white, appears in different places along the shores. Some indications of metallic ores, as those of iron and lead, have been observed, but they have not been prosecuted or wrought. The chief supply of fuel is derived from extensive tracts of peat in the interior districts of the county.

Population, towns, &c.—The population of Banffshire was estimated in 1801 at 35,807, and in 1811 at 36,668. The real rent of the county was stated in 1798 at L.43,490 Sterling. Beside the usual labours of agriculture, the inhabitants are engaged in the manufactures of linen and woollen, in bleaching, tanning, and distilling. The white fisheries along the shores, and the salmon fisheries at the influx of the larger rivers into the sea, afford active and profitable occupation. The salmon-fishing on the Spey sometimes yields an annual revenue of L.6000, and that of the Deveron at Banff L.2000.

Banff, the capital of the county, and Cullen, which are royal boroughs, Portsoy, Macduff, Gardenston, and Troup, are the principal towns and villages. Cullen, Portsoy, and Macduff, contain each about 1000 inhabitants. Linen and damask manufactures, with fishing, are the chief occupation of the inhabitants of Cullen. The manufacture of thread and linens is carried on at Portsoy; and the fisheries on the coast, and the digging out and polishing of serpentine, give employment to another portion of the population. Macduff, which is at the distance of a mile from Banff, is also a fishing village, with a pretty good harbour, and some trade to Leith and London.

Husbandry, &c.—The agriculture of Banffshire, from the nature of the soil and surface, is not conducted on a large scale. Modern improvements have not been neglected, and their beneficial effects appear in the abundance and luxuriance of the cultivated crops. But a large proportion of the county is better fitted for the grazing system. Besides domestic consumption, the hilly pastures of Banffshire afford a considerable supply of sheep and cattle to the markets of the south.

The hand of art has not been slow in improving the beauties of nature in those places which have been selected for the residences of some of the great proprietors in this county. Duff-house, the elegant mansion of the Earl of Fife, stands in a fine lawn surrounded with extensive plantations, in the vicinity of Banff; Cullen-house, a seat of the Earl of Findlater, occupies a romantic and well wooded spot, on the banks of the river, near the town of Cullen; and the princely residence of the Duke of Gordon, on the banks of the Spey, although not included in the county, is a magnificent ornament to its western boundary.

Antiquities.—Numerous remains of castles and baronial residences are still visible in Banffshire; and various places are still commemorated where the Scots defeated and triumphed over the Danes, long a troublesome and active foe on the northern shores of the kingdom; but if it be true that the skulls built in the walls of the old churches of Gamrie and Mortlach, belonged to their invaders, it must be admitted that our ancestors have chosen a barbarous and unseemly monument as a memorial of their victorious struggle.

In the interior districts of Banffshire, the Gaelic as well as the English language is spoken by the inhabitants.

BANFF, the capital of the county of the same name in Scotland, stands on a declivity on t e western bank of the Deveron, and near its influx into the Moray frith, is a royal borough, and joins with Cullen, Elgin, Inverury, and Kintore, in the election of a member of Parliament. Banff was erected into a royal borough in 1372; but traditionary history carries back the date of its erection to a remoter period of antiquity.

The situation of Banff is airy and agreeable. Some of the public buildings lately erected, and the bridge over the Deveron, are elegant structures. The population exceeds 3000. The principal manufactures are linen, stockings, thread, soap, and candles; and a portion of the inhabitants are engaged in brewing, rope and sail-making, and in the extensive salmon-fishery at the mouth of the Deveron. The harbour has been improved. Grain, cheese, and butter, salmon, cod, and ling, are exported, and the imports consist of all kinds of goods for the supply of the town and neighbourhood.

An academy, established in 1786, is still ably conducted by proper masters, who instruct the youth in the knowledge of languages and in the various practical branches of education. Banff is 165 miles from Edinburgh.

BANGOR, a small city of Caernarvonshire in North Wales, stands at the head of a bay of the same name, and near the northern extremity of the straits of Menai, and is a place of great antiquity, as appears from the see having been erected in the sixth century. A single street, not very regular, includes the whole population of nearly 2000; and from Penrhyn harbour, in its vicinity, great quantities of roof-slate are exported to London and other places of the kingdom. Bangor is 250 miles north-west from London.

BANGOR, a sea-port town of the county of Down in Ireland, stands on the south side of Belfast or Carrickfergus lough. The situation is dry and agreeable; the streets are spacious and clean; many of the houses are neatly built, and the harbour admits only vessels of small size.

BANIAN TREE, the *ficus religiosa*, Lin. is a singular vegetable production, which is the object of great veneration among the natives of eastern regions, and hence the origin of the specific name. From the horizontal branches of this remarkable tree suckers are sent off, which stretch toward the earth, strike into the soil, and take root, and at last, from one plant, an extensive grove is produced. In some parts of India the banian tree may be regarded as a kind of natural temple.

BANIANS, a religious sect in India, whose belief in the doctrine of transmigration of souls is so strong, that they will not destroy any living creature, even the most noxious animals, on any account whatever, and are so extremely scrupulous in their intercourse with persons of any other religious faith, that they regard themselves as polluted by touching them, or the vessels they use. The appellation, *Banians*, is applied generally to all the idolatrous tribes of India who are not of the Mahometan persuasion; but, in a more restricted sense, it denotes one of the four principal Indian casts. The Banians form the class of merchants, and, consequently, all commercial affairs are managed by them. They are the brokers and bankers of India, and are described as a frugal, honest, and humane people.

BANK, an institution for facilitating commercial transactions, by affording security for money, issuing a convenient substitute for coin or bullion, and effecting payments of accounts, or settlements of balance, between parties at a distance. It is a modern invention, which has had the most important operations on the interests of the different kingdoms and states where it has been established, and, consequently, merits very particular consideration. The general principles form a striking feature in commerce, as now carried on throughout Europe. It is proposed to give a summary account of some of the most remarkable examples of the institution.

Bank of Venice.—The first regular bank appears to have been established at Venice in the middle of the 12th century, and has served as a model to which, on the whole, succeeding times have pretty uniformly adhered. It originated in the embarrassment of the republic's finances, occasioned by long and expensive wars, which required the aid of a LOAN from the subject. The contributors to this expedient became creditors of the state, which was security for the debt, and engaged to pay an interest of 4 per cent. per annum. An office was appointed for the regular discharge of this interest, and the management of the general fund. This, under various judicious laws, and sundry modifications of the original plan, constituted the Bank of Venice, which by its good faith, punctuality, and extensive concerns, attracted universal admiration, and conferred the most essential benefits on Europe. Its prosperity was greatly owing to an edict of the government, which enjoined the larger payments of merchants to be made in its own notes, and required debtors to lodge their money in the bank, for which a transference was made to the amount in the name of the creditor, who was paid not in money but in *banco*, or bank notes, except in certain peculiar cases, where coin was needed for retail, or to be taken abroad. In this way the wealth of the state flowed into the bank, to be used as opportunities of profiting itself and benefiting the community presented.

Bank of Barcelona.—At the distance of nearly three centuries, the magistrates of Barcelona established a kind of bank, under the title of "Table of Exchange," which properly enough indicated its nature and object. It negociated bills of exchange as well for foreigners as for natives, and therefore vastly promoted the interests of commerce. The city itself was responsible for the validity of this institution.

Bank of Genoa.—The bank of Genoa commenced in the beginning of the 15th century, also under the sanction and with the security of the government. Its management was generally entrusted to a board of the citizens, but frequently underwent modifications, to suit a change of circumstances occurring within half a century from its origin. Bills of exchange, and other pecuniary instruments, were become prevalent throughout the Italian states, chiefly owing to the revived commerce with the East, and were generally transacted in some of the institutions now mentioned.

Bank of Amsterdam,—a remarkable establishment, bearing a somewhat different character, opened at Amsterdam in 1609. The extensive, and extending trade of Holland, in which this city so largely participated, brought immense quantities of foreign, debased, and injured coin into the market, so as to perplex and impede mercantile transactions, and give occasion to various fraudulent and injurious practices. In order to prevent or remedy these and other inconveniences, the magistrates, with the authority of the States, erected a bank-office for the reception of every kind of coin at its real intrinsic value, in the standard money of the country, for which, after a small deduction for defraying the expence of recoinage and other necessary demands, they gave credit in their books. They thus declared themselves the perpetual cashiers of the inhabitants; and as, for the more effectually answering the purposes intended, they required all payments above a certain sum, and bills of exchange, to be made in the bank, merchants were necessitated to open accounts with it, and to use its notes in their cash transactions. These notes, or bank receipts, in fact represented property no less effectually than money, and had the important advantage of being far less variable in value, besides being more readily conveyed, and as capable of transfer. Bank money, therefore, bore a premium from the commencement, and consequently few persons cared to ask payment in specie at the bank, where it was generally believed to be preserved to the full amount of current paper. An additional reason for declining such a step, was the circumstance of a certain proportion of the sum being demanded as a charge for keeping the money that had been deposited. The amount of the capital of this bank was never correctly known. It originally consisted of the whole coin deposited in it, and which the bank was bound to restore on demand. But in process of time, and from various causes of prosperity, the capital became vastly larger. The city was security that there should always remain as much bullion in the bank as corresponded to the receipts issued by it; and there is every reason to believe that, amid all the revolutions which occurred in the government of Amsterdam, this condition was faithfully maintained. Its management was committed to the four reigning burgomasters, who were chosen every year. It was their duty, on coming into office, to visit the treasure, and compare it with the books; they received it with oaths, and in the same manner delivered it over to their successors. An evidence of the caution and conscientiousness with which its concerns were conducted, is exhibited in the fact, of there being no example of accusation against any of the parties to whom it had been successively entrusted, in the course of their political ascendancy. The city of Amsterdam derived a very considerable revenue from its bank, but was still more indebted to it for the promotion of its mercantile interests and its consequence among the commercial states of Europe.

Bank of England.—In the year 1695, a charter of incorporation was granted by William and Mary of England, to certain individuals, under the name of "The Governors and Company of the Bank of England," in consideration of a loan of L.1,200,000 to government, at the rate of 8 per cent. interest, and the additional allowance of L.4000 in lieu of house expenses.

Original constitution.—The merit of projecting this stupendous establishment is due to William Paterson, a native of Scotland, assisted by Michael Godfrey, a respectable gentleman of London. They appear to have taken the Bank of Genoa for their model. The charter, which was granted for twelve years, debarred the company from borrowing under their common seal, without act of Parliament, and also their trading, or suffering any persons to trade for them, in any goods or merchandize, but permitted their dealing in bills of exchange, and trafficking in bullion and foreign coin. By the constitution of the company, a governor, deputy-governor, and twenty-four directors were to be elected from the proprietors annually, for the management of the common concerns, but not more than two-thirds of the directors of the former year could be chosen. A requisite qualification of a governor was the possession of L.4000 stock; and of a director, the half of that quantity; and the electors were to hold L.500 stock in order to be entitled to vote at general courts.

Increases its capital.—By an act of Parliament in the 8th and 9th year of William, the company enlarged their capital stock to L.2,201,171, 11s. Bank stock was now declared a personal and not a real estate; and it was now enacted, that to counterfeit or forge the common seal of the bank, or any bank-bill or note, or to alter or erase such, shall be felony without benefit of clergy. The advantages which this establishment conferred on the community, and the support it was capable of rendering to the government, seemed to entitle it to every encouragement and protection which the laws could effect. The capital was doubled in the 7th of Queen Anne, when the company advanced L.400,000 more to the government; and in 1714 a farther advance was made of L.1,500,000. In the 3d year of George I. the bank agreed to cancel L.2,000,000 of exchequer bills, which made the total advance to government amount to L.5,375,027, 17s. 10½d.; the interest on the capital stock was now reduced to five per cent; and it was permitted to the bank to call from its proprietors such sums of money as a general court should think necessary, in proportion to their interests, under certain penalties on non-compliance. The interest on the last L.2,000,000 lent to government was afterwards reduced to four per cent.

By the year 1746, the bank had advanced to the government, on various occasions, L. 11,686,800, which formed its undivided capital, while its divided capital, which had been accumulating by several calls and subscriptions, amounted to L.10,780,000.

Renews its charter.—Loans.—In consideration of the renewal of its charter the bank agreed, in 1764, to pay government L.110,000, and to advance L.1,000,000 on exchequer bills, to be returned in 1766. The charter was accordingly extended to August 1786, and the interest on the stock was raised. A farther extension of the charter to August 1812, was afterwards obtained by an advance of L.2,000,000 on exchequer bills, at three per cent. In order to effect this advance, a call was made on the proprietors of eight per cent. on the capital stock, which was, therefore, increased to L.11,642,400, the dividend being at the same time raised to six per cent. The total advances to government, on the security of certain taxes and duties, and exchequer and treasury bills, amounted, in 1782, to L.9,991,678, which was reduced in 1786 to L.6,634,872. Comparatively small, though frequent, fluctuations took place between this period and 1800, when, in consideration of a farther renewal of the charter to 1835, the bank agreed to advance the sum of L.3,000,000 for the public service, free of interest, during six years. On the expiry of this term in 1806, it was at last determined that this loan should be prolonged during the war, at an interest of 3 per cent. This was certainly an accommodation to the public; but in the following year the chancellor of the Exchequer thought himself entitled to some farther compensation for the profits made by the bank on the sums of public money then deposited in it, and which amounted to nearly L12,000,000. Another loan was accordingly granted of L.3,000,000, free of interest, until six months after the conclusion of a definitive treaty of peace. Both these loans becoming due in 1814, that of 1806 was liquidated, but the other was renewed till April 1816. A new arrangement was then made, by which this was prolonged at 3 per cent. interest, in return for permission to add L.2,910,600 to the bank capital. Government was farther accommodated at the same time by an advance of L.6,000,000, at the rate of 4 per cent. In this manner the debt of the public to the Bank of England has accumulated to the enormous sum of L.20,686,800.

Circulation.—The circulation of Bank of England notes has progressively increased in successive periods from the year 1718, but not in consecutive years. This is proved by accounts laid before Parliament, from which some particulars may be extracted, illustrative of the growing prosperity of this institution.

In 1718 the amount of notes issued, which were all for L.5 and upwards, was L.1,829,930. In 1754, including bank post-bills, the circulation amounted to L.3,975,870. In 1778 it was very nearly double this sum, being L.7,540,070; but it fell somewhat short of this in 1783 and 1784. In 1791 it reached L.10,689,510, and increased in the two following years. Then there took place a gradual diminution for four years, so that the amount in 1797 was only L.9,204,500. During the next year, in which notes under L.5 were issued, in addition to those for larger sums, as formerly used, the amount was L.10,778,120. A rapid augmentation followed till the year 1802, when the circulation was L.16,244,115. The next year displays a falling off, the amount being only L.14,971,170. The fluctuating, but remarkable increase for the last eleven years will be seen from the following table:

Year.	Amount.
1806	L.16,432,380
1807	16,035,950
1808	16,919,275
1809	18,105,855
1810	19,452,930
1811	21,781,380
1812	23,881,710
1813	23,686,105
1814	25,517,550
1815	26,803,526
1816	26,594,360

Profits.—The profits of the Bank of England arise from various sources, of which the chief are: the interest paid by government for the loan of money; the allowance made for managing the public debt, which, in 1726, was L.360 *per* million, increased afterwards to L.562, 10s. but reduced, in 1786, to L.450, at which it continued till 1807, when it was farther reduced to L.340 *per* million, on the first *six hundred millions* of debt, and to L.300 *per* million on the excess above that sum; the allowance for receiving contributions to loans, and paying dividends on the public funds, the former being L.800 *per* million; an allowance on every lottery contract of L.1000; an allowance for advances on exchequer bills, or accommodating government with temporary sums on security, or in anticipation of the proceeds of taxes; the interest of stock held by the company in any of the public funds; the purchase and sale of such property as the law allows; and the discounts on bills of exchange, and the vast circulation of its notes, especially since the suspension of cash payments in 1797, to be immediately explained. The increased operation of some of those causes, during the last wars, is imagined, on good grounds, to have yielded about 25 millions of profit in less than twenty years. The dividend on the shares has consequently improved, and there has been a corresponding rise in the value of its stock. Thus, in 1797, bank stock was averaged at about L.125 *per cent.* whereas at present (1817) its market price is more than double that sum.

Suspension of cash payments.—The alarm of the country in 1793, had an injurious effect on public credit. Specie became scarce, paper-money was depreciated; the bank, unusually called on to answer its current notes, thought it necessary to refuse assistance to the mercantile community, and, on the same principle, scrupled to increase its issue of paper. The consequences were, a general deficiency of money, and the prevalence of bankruptcies. Parliament came forward to the relief of the commercial public, by the offer of a loan to a large amount, in the form of exchequer bills, which had the most salutary effects. Confidence was restored, money circulated freely, and a state of comparative prosperity ensued till 1795. The bank then became less liberal in discounting bills, in consideration of the large advances made to government. A similar effect to what had been before experienced was the result; and this was vastly aggravated in the following year, by the apprehension of invasion, which induced a rapid and large demand for specie at the bank, in place of its notes, now considerably discredited, and justly thought useless, in the event of such an apprehension being realised. The bank, in order to remedy or prevent the excessive drain of its coffers, diminished its circulation. This augmented the distress, and ultimately even quickened the demand for specie. In these circumstances, and fearing the exhaustion of their coin, the directors held communication with the minister, the result of which was an order in council, dated on Sunday, the 26th February 1797, to suspend the payment in specie, which was soon afterwards confirmed by an act of Parliament, and has since been renewed till 1818. The utmost surprise and alarm followed this memorable event, which, however, after very serious discussion, received a parliamentary justification. Some other steps were afterwards required to give full effect to this suspension; of these, the most important was an act rendering Bank of England notes a legal tender in payment of debts. The public got gradually accustomed to this new system, and for several years transacted business with very little aid from the precious metals.

Banks in Scotland.—The Bank of Scotland was established within a year after the Bank of England, and on the suggestion of the same individual. Its original capital was L.100,000 Sterling. The affairs are managed by a governor, deputy, twelve ordinary, and twelve extraordinary directors, elected annually. It has many branches in the country towns, and is understood to have proved a prosperous concern. The Royal Bank of Scotland, which was not established till 1727, is conducted on similar principles.

There are few large towns in England or Scotland in which banks are not established, on the security of individuals or companies. These generally discount promissory notes, and in many instances issue notes of their own, besides undertaking the more common, but highly beneficial business, of negociating accounts, by the purchase and sale of bills, and the reception and transmission of money.

Cash Accounts.—A peculiarity in several of the Scotch banks has greatly contributed to succour the industry and spirit of enterprise in the people. This is the system of cash accounts, which are powers granted to individuals, or companies, on security of sufficient persons, to draw out money to a certain amount, at the rate of five per cent. to be afterwards returned or accounted for, at an agreed on time of balancing. Such accommodation is equivalent to the occasional loan of money, and enables those who have no capital of their own to engage in extensive and profitable concerns. The banks themselves are benefited by it, by the circulation of their notes, in addition to the interest for money advanced; farther, it is believed they have rarely been injured even by the failure of the party, as according to the bearing of the bond, which specifies the nature of the transaction, all the persons who sign it are conjointly and separately responsible to the full amount of the sum drawn. These persons are generally known by the name of cautioners, and are usually two or three in number, the friends of the party obliged, and of approved respectability and substance.

Bank of Ireland.—The Bank of Ireland was established in 1783, with a capital of L.600,000, which was given to government in loan at 4 *per cent.* There was nothing peculiar in its management. Its charter was renewed in 1809, on conditions of its adding to its capital one million of stock, to be raised by a contribution from the proprietors at the rate of L.125 *per cent.* and disposed of to government in loan at 5 *per cent.* and its engaging to manage the public debts and loans free of charge to government. Something like this last service has been suggested, it may be mentioned, as due by the Bank of England, in return for the profits on the public funds committed to it, and the balances remaining with it, which are said to have been sometimes to a great amount. The bank of the United States is understood to act on this principle, and to charge nothing to government for managing the public debts; and it was lately mentioned, (February 1817), in the House of Commons, by Mr Grenfell, to whom the country is much indebted for his labours to bring the whole subject of the Bank of England before the public, that the Globe Insurance Company had, in reality, offered to ease the government of this expence. In times of distress, like the present, Parliament may be expected to devise some means for accomplishing so desirable a saving. But, to return.

The suspension of cash payment in 1797 extended to Ireland, after which its bank circulation so largely increased as to produce a rise in the price of bullion, and a depression in the value of paper money. Serious inconveniences were the result, till within these few years, in consequence of interference on the part of the legislature to check an exorbitant issue of private notes for small sums, and other evils, bank paper has been restored to its credit. The price of Irish bank-stock has been on the rise for the last twenty years.

Some particulars, in the history of the two French banks, deserve to be recorded.

First bank of France.—The first, which was projected by the famous John Law of Lauriston, in Scotland, was opened at Paris in 1716. Its objects, according to that singular man, were most beneficial; "to increase the quantity of circulating coin, check the progress of usury, promote the exchange between the metropolis and the provinces, allow foreigners an opportunity of acquiring funds in the kingdom, and enable the people to pay the heavy taxes imposed on them;" its general plan and arrangements were certainly judicious and commendable. The original stock might amount to L.300,000 Sterling, of which Law and his brother William were the principal proprietors. The only recompense he required for the benefits thus promised, was the privilege of managing the bank for twenty years, and permission to reckon by bank-crowns in all his transactions, as always of one weight and denomination, and consequently not liable to fluctuation in value. This last condition was asserted to be essential, in order to acquire the confidence both of natives and foreigners. The project had a flattering aspect, and obtained the sanction of government. Its immediate effects were most agreeable. Exchange with Holland and England rose in favour of Paris; at the general meeting of the proprietors in December 1717, a dividend was ordered at $7\frac{1}{2}$ per cent. and bank-bills continued to rise in value; whereas the state bills and bonds which had been given as security for debts contracted in the last years of Louis XIV. were declining.

Anquetil, who writes memoirs of the reign of that monarch, and the regency of the duke of Orleans, relates some curious circumstances respecting the early history of this bank, and the kind of traffic or gambling to which it gave rise. In addition to several grievances, the consequence of imprudent policy about this period, many families sustained loss by the depreciation of the state bills. According to him sixty-eight and a half was at one time lost on securities, while bank-bills rose 15 per cent. The treasurer received the former at $31\frac{1}{2}$ per cent. and delivered in payment the latter at 115. In this manner the public debts were discharged for a trifle, and the government carried on a gainful trade in paying them, though to the ruin of individuals, who were in fact pillaged of two-thirds of their property.

The anxiety to get rid of the discredited state-bills was vastly enhanced by a notion which was diligently propagated, that they would constantly fall in value till they were worth nothing; whereas on the contrary, the bank, supported as it was by a participation in the Mississippi trade and other extraordinary advantages, was sure to succeed, and materially enrich those who were concerned in it. A set of stock-jobbers now arose, who availed themselves of the occasional fluctuations between the two securities. When the state-bills fell low, these speculators purchased them in hopes of their rising, and immediately on their doing so, to however inconsiderable an amount, sold them for bank-bills. On the other hand, Bank.

when the latter appeared to be either stationary or to fall, these persons affected eagerness to possess government security; by which stratagem they were enabled to buy bank-stock at an under rate, though they were well aware that its credit would be speedily restored. Such alternations would often occur in the course of one day, and appear to have been skilfully managed. Law himself was not the least dexterous operator in these times, and in a short period amassed immense wealth, which naturally excited suspicion and jealousy. But he had a good friend in the regent, who protected him for some time against the decree of Parliament for his arrest.

When bank-bills became at length in less request, this ingenious projector invented a new expedient to raise their value. This was contriving to make money fall in value, by supporting the bank-crown at its original value. People were consequently induced to carry the former to the bank, in order to receive its bills in exchange, which were subject to no fluctuation. Government had by this time identified itself with the bank, and appears to have taken little care to obviate the serious and fraudulent measures by which its interests were attempted to be promoted.

All ranks of people were now seized with a kind of madness at sight of the immense fortunes which had been almost instantly made in the bank transactions. An individual commencing with a state-bill, was sometimes known, by exchanging it for silver, and that again for other bills, to realize some millions of livres in a few weeks. One street in Paris became noted as the resort of these traders, and the theatre of their operations. It was constantly thronged in such a manner, that several persons were crushed to death. But this calamity did not deter others, as any one who got firm footing in it was almost certain of making his fortune. Among the singular instances of this kind which occurred, is mentioned the fact of a certain deformed man, who in a short time gained more than 50,000 livres, by offering the hump on his back as a desk to such persons as had writings to sign!

But these favourable revolutions were the lot of comparatively few individuals. The general result was calamitous in the extreme. Trade and social intercourse ceased, the attention of every one being engaged to the price and variation of stocks; the hope of success dissolved every tie of honour, generosity, and friendship; the most sacred bonds of morality were completely broken; suicide, assassination, and all the crimes which avarice excites, followed in a train, and completed the catalogue of misery. An edict of the government on the 21st May 1720, reducing the bank-stock to one-half, interrupted the dream of opulence in which the public had indulged. This was said to have become necessary in consequence of the issue of paper much beyond what the bank could pay. It gave the death-blow to the whole system which Law had been erecting on the cupidity and ambition of the people. Notes fell in value, in spite of all the suggestions of his genius, and the influence of the regent's authority. Before the conclusion of the year, the bubble had entirely broken, and Law himself, narrowly escaping the violence of the populace, sought safety in flight.

Bankruptcy.

Second bank of France.—The New Bank of France was erected in 1803, on the consolidation of different banks, by an act of the government, which fixed its capital at something short of two millions Sterling, divided into 45,000 shares. The regulations for its management deserve every praise; and its prosperity, notwithstanding the critical condition in which this country has been frequently placed since its establishment, is the best criterion of the judgment and prudence displayed in its constitution. But it has necessarily met with difficulties.

A *run* was made on it for specie in 1805 and 1806, which at last occasioned it to suspend its cash-payments. In this last year a change took place in its administration, and its capital was doubled. The profitable disposal of the new shares, enabled it to recover and augment its operations.

The invasion of 1814 was a serious trial of its strength, as an immediate drain of its coin commenced. In the month of January of this year, it found it necessary to limit, though not to cease the payment in specie; and in the following month it was enabled to resume the issue of cash in full on demand, though the emergencies of the state, as is well known, were mightily magnified. The invasion which again took place in 1815, did not suspend cash-payments for a single day. So much for the fidelity of this establishment, in circumstances not to be parallelled in the history of any other country.

Banks of America.—The chief bank in America is that of the United States, established, in 1791, on a capital of ten millions of dollars. We know not any peculiarities in its constitution or history which merit notice. A new bank has lately been proposed at Philadelphia, in order to obviate the inconvenience experienced in that country from want of a uniform currency. Congress has given it encouragement, and the necessary capital has been subscribed for; a pretty general conviction of its necessity, and the commercial intelligence and ardour of the people, are the best guarantee of its benefits.

BANKRUPTCY, a state of insolvency, or the state of a trader's affairs when he is unable to discharge the just demands that are made upon him. In the early ages of society the laws and regulations of most states relative to insolvent persons, were severe and oppressive. Whatever might be the cause of his insolvency, whether from unavoidable misfortune, or culpable negligence in the management of his affairs, the debtor was regarded as a criminal, and the interest of the creditor only was consulted. But in the progress of civilization, and the extension of commercial affairs, the statutes and enactments on this subject took a wider range, and while the advantage of the creditor was not overlooked, the character and feelings of the unfortunate debtor were duly considered. The great object of the bankrupt laws of this country is to throw the whole property of the insolvent person into one fund for the benefit of his creditors, and to distribute this common fund by the most economical and speedy process, as far as it will go, in discharging the debts. The same general principles pervade the bankrupt laws of Scotland and England, but in many of the details and minuter parts the difference is considerable.

Bankrupt law of England.—According to the bankrupt law of England, traders only are subject to its operation. Persons of every other description are liable to the common law, and their effects may be attached by individual creditors. The marks of insolvency, or bankruptcy, are defined by the statute; as, when the debtor is inaccessible to his creditors, and cannot be seen or spoken to by them. The commission of any of the acts enumerated in the statute entitles a creditor, to a certain extent, to apply to the Lord Chancellor for a commission of bankruptcy. By this deed the estate of the insolvent person is vested in certain commissioners. As it may be granted without the bankrupt's knowledge, certain precautions must be observed to prevent improper and malicious applications.

It is the business of the commissioners to take proof of the bankruptcy, and of the debtor's being a trader, and to appoint three meetings by public advertisement. At these meetings the debts are proved, assignees are chosen, and the bankrupt must surrender himself, and, under pain of death, conform to the statutes. The bankrupt, and those connected with him, are to be examined by the commissioners on the state of his affairs; and if their answers appear to be ambiguous or evasive, the commissioners have the power of committing them to prison till they give a satisfactory explanation.

The estate of the bankrupt is now vested in the assignees, and when they have recovered all they can, they are required, after four months, and within twelve, to give notice of a meeting for a dividend, which the commissioners then direct to be made. Within eighteen months from the time of issuing the commission, a second and final dividend is ordered; and the surplus funds, after payment of the debts, belong to the bankrupt.

The bankrupt having conformed in all respects to the statutes, and the creditors, or four-fifths of them in number and value, having signed a certificate to that purpose, the commissioners are required to transmit it to the Lord Chancellor, who, upon a declaration on oath by the bankrupt that it was obtained without fraudulent means, may either allow the same or disallow it on cause being shewn by any of the creditors. If it be allowed, the bankrupt is entitled to a certain portion of his effects to assist him in recommencing business. The amount of this allowance is proportioned to the dividend on his estate, but it must never exceed L.300. By the certificate the bankrupt is also relieved from all claims for any debts which were either proved or might have been proved under the commission.—*Cooke on the Bankrupt Law of England.*

Bankrupt Law of Scotland.—By the bankrupt law of Scotland, all persons who are engaged in trade for themselves, or as agents or factors for others, or all persons who are capable of entering into trade, are liable to the process of sequestration. But holders of India stock, or stock in any chartered bank, in the Friendly Insurance Company, the Forth and Clyde, or other inland navigation, or in the British Fisheries, labourers who work for hire, landholders, and husbandmen, are excepted; and a foreigner who has traded to Scotland, or a Scotsman domiciled abroad, is not subject to sequestration.

The assent, or acknowledgment of the insolvency by the debtor himself, is admitted as a proof of bankruptcy, and supersedes other evidence. But without this concurrence certain previous processes are necessary, and the creditor, before sequestration can be granted, must shew that such have been pursued; as diligence by horning and caption for debt, imprisonment, retiring to a sanctuary, or absconding, or defending his person by force; or being out of Scotland, and not liable to be imprisoned, by reason of privilege or personal protection, and at the same time under diligence by charge of horning, attended with arrestment, or poinding any part of his moveables; or decree of adjudication for any part of his estate, either for payment or security of debt, at the instance of a creditor.

A person being bankrupt, one creditor to the amount of L.100, or two creditors to the amount of L.150, or three or more to the amount of L.200, either with or without the concurrence of the bankrupt, may apply for a sequestration to the Court of Session by summary petition. With the concurrence of the bankrupt, sequestration is immediately granted; but if this assent be refused, he is served with the petition, and if he decline to appear, the sequestration is allowed. The creditors are appointed to meet, and choose an interim factor for the management of the estate, and at the second meeting to nominate a trustee. The factor takes possession of the whole estate of the bankrupt, and the latter is bound to grant powers of attorney to recover any effects he may have abroad. The second meeting appointed by the Court must take place within six weeks, and not less than four weeks from the first deliverance on the petition; and at this meeting the creditors must produce the grounds of debt, with affidavits or oaths of verity; and at the same meeting the trustee is to be chosen by a majority of the creditors in number and value; the bankrupt must exhibit a state of his affairs, and the interim factor must present an account of his management.

The trustee having given security to the creditors for his faithful management, is confirmed in his appointment by the Court, and has the whole estate vested in him for behoof of the creditors. Within eight days of his nomination, the trustee must apply to the sheriff to fix two days for the examination of the bankrupt, and, if necessary, those concerned or connected with him. After the last examination, a general meeting of the creditors is held, at which three commissioners are chosen to superintend the management of the trustee.

The trustee is bound to keep regular accounts, and to lodge the money recovered in a bank; and at the end of twelve months a dividend shall take place to those creditors who have established their debts; at the end of eighteen months a second dividend, and at the end of every six months till the whole funds are paid up. But at the end of eighteen months from the sequestration, four-fifths of the creditors may order the whole concern to be brought to a close, by the sale of the outstanding debts, and making a final division.

With concurrence of the trustee and four-fifths of the creditors, the bankrupt may apply to the Court, after the second dividend, for a final discharge of all debts contracted before the sequestration; and if no valid objection be offered, such discharge is granted. After the second examination, the bankrupt has it in his power, by the statute, to offer a composition; and if this offer shall be approved by nine-tenths of the creditors, another meeting is called to consider it; and if nine-tenths still approve, and the Court, to whom the report is presented, pronounce it reasonable, the proceedings in the sequestration are closed, and the bankrupt is discharged, on giving satisfactory security for the payment of the composition.—Such were the general enactments of the bankrupt law of Scotland previously to 1816, when some alterations were introduced by an act of Parliament passed in that year, of which the following is a sketch.

1st, Trustees who fail to deposit the funds in bank, in violation of the act, are in future to forfeit to the estate a penalty of 20 per cent. on the amount, instead of $7\frac{1}{2}$ per cent. as was provided by the former act.

2d, The funds of the estate are not to be deposited in any bank where the factor or trustee shall be an acting partner, manager, or cashier.

3d, The commissioners are to meet periodically, (once in three months at least,) to examine the trustee's accounts, and to see that the funds are duly deposited in the bank, and that none are drawn out of it but for the purposes of the estate.

4th, Previously to the meeting when the commissioners are chosen, and when a composition may be offered, the trustee is to make out a full state of the bankrupt's affairs, with a valuation or appraisement of what the estate is worth, that the creditors may be enabled to judge of the fairness of the offer.

5th, The commissioners may at any time make out reports to the creditors, that they may know how the affairs are managed by the trustee.

6th, Notice of the bankruptcy—of the meetings for electing factor and trustee—of compositions—of the payments of dividends—and of the trustees application for a discharge, are to be inserted both in the Edinburgh and London Gazette.

7th, Printed notices are to be sent to every creditor who has claimed, of the payment of dividends and of the offer of a composition.

8th, Creditors who hold securities are to deduct their value in voting, and only to vote on the balance of their debt so far as uncovered.

9th, The trustee is not to be discharged by the court, without first calling a general meeting of the creditors, and having his accounts audited.

10th, At the end of three years the trustee is to make up a state of the affairs (if not wound up before), and also of the unclaimed dividends, and to call a general meeting of the creditors to receive instructions as to the final close of the sequestration.

11th, A printed report of the affairs is to be made out at the close of the sequestration, and distributed to the creditors for their satisfaction.

12th, Current sequestrations are to be proceeded in according to this act, so far as it does not interfere with the proceedings already had; so that any sequestration which has been pending for above three years may now be brought to a conclusion, and all unclaimed dividends accounted for to the creditors.

13th, The factor, commissioners, and trustee, are appointed by the creditors, as by the former act; and the duration of the law is for seven years.

BANK, SAVINGS, an institution which has been recently established in various parts of Britain, for the purpose of affording interest for small sums of money, which could not be conveniently deposited in banks according to the ordinary method of transacting their business.—See INSTITUTION, *Economical*.

BANKSIA, a genus of plants belonging to the Tetrandria class, and intended to commemorate the name of Sir Joseph Banks, in consideration of his exertions in promoting natural knowledge.

BANNERETS, an order of knights, who led their vassals to battle under their own flag or banner, by which they were distinguished from knights bachelors, who fought under the banner of another. The name is derived from banner, which signifies a *square flag*; for when this honour was conferred, the knight approached the monarch with his pennon in his hand, and, having reached the royal presence, the king commanded the ends of the pennon to be cut off, so that it was converted into a square flag or banner. Knights-bannerets were next in dignity to barons; the honour was usually conferred on the field of battle as the reward of personal bravery, but it was not hereditary. Sir John Smith, who rescued the royal standard from the rebels, was invested with this honour by Charles I. after the battle of Edgehill, and he is said to be the last who was formally created a knight-banneret; but after the battle of Camperdown, so glorious to the British fleet, under Lord Duncan, his Majesty's intention of conferring that honour on his lordship's flag-captain, and another officer, on board their own ships, when the fleet arrived in the mouth of the Thames, was frustrated by indisposition; but though the formal investment did not take place, the title and honours were granted and enjoyed by the individuals for whom they were intended.

BANTAM, a sea-port town of the island of Java in the East Indies, the capital of a kingdom of the same name, and a place of considerable trade before it was monopolized by the Dutch. Pepper was the chief commodity of this trade, and it is said that the annual exportation amounted to three millions of pounds. See JAVA.

BANTRY BAY, called also BEERHAVEN, a spacious bay in the county of Cork, and on the south-west coast of Ireland, is about twenty-five miles long, and varies in breadth from three to five miles, and is capable of admitting and affording shelter and safe anchorage to any number or magnitude of ships. In 1689, the French fleet which brought arms and ammunition to James II. was attacked in this bay by the British admiral, and, in 1796, a French fleet arrived in it with troops for the purpose of invading Ireland; but being either disappointed of co-operation, and thus discouraged to make the attempt, or being disabled by the storms which they had experienced in the passage, the fleet soon after left the coast.

BANYAN TREE. See BANIAN.

BAOBAB, the trivial name of the African calabash tree, a species of Adansonia in the Linnean classification. The trunk of the tree, which rarely exceeds 12 feet in height, acquires an immense thickness; the branches extend horizontally, or rather in a pendent form to a great distance, and become a close mass of foliage not less than 100 feet in diameter.

BAPTISM, from the Greek, and signifying *dipping in water*, is the rite or sacrament by which a person is admitted a member of the Christian church. Various opinions have been held concerning the origin of baptism, whether it is to be sought for among the Jewish ceremonies, or commenced with the mission of John the Baptist,—of the manner in which it ought to be practised, whether by immersion, as is supposed to have been the case in the time of the apostles, or by sprinkling, the mode adopted by many churches,—of the end and design of baptism,—of the time and place of performing this religious rite,---and of the proper subjects to whom it ought to be administered, whether infants ought to be admitted, or persons only who are capable of understanding its meaning and objects. The ceremony of baptism is regarded by some sects of Christians as forming no part of the religious ordinances of the gospel. The Quakers maintain, that it was intended for the Jews on account of their prejudices, or, having a reference to the mystical purification of the soul, that it was only requisite to be practised at the first introduction of Christianity. The forms and ceremonies observed in the administration of baptism, have been different at different periods, and in different churches; and some diversity of opinion has prevailed with regard to the persons who should celebrate that rite,—whether the commission to baptise is limited to the professed ministers of the gospel, or whether, in certain cases, it has not been extended to laymen, and even to women. Bingham *Origines Ecclesiasticæ*. Mosheim *Church Hist.* Robinson's *History of Baptism.*

BAPTISTERY, a place in which water appropriated to the administration of baptism is kept. The first edifices destined to this purpose were erected, it is supposed, about the middle of the third century; they were originally at a distance from the churches; and it is said that the first example of a baptistery connected with a church, was that which was erected in 496, adjoining to the cathedral of Rheims, for the baptism of Clovis, king of France, who had been converted by his queen. Some of these buildings were elegant structures; they were usually of an octagonal form, with a cupola supported by eight pillars; in the middle was a large hall for the priests and attendants; and a bath, corresponding with the form of the building, occupied the centre of the hall. The inside of the cupola was sometimes richly decorated with Mosaic work and emblematical representations. Fonts for the baptism of children were afterwards erected in these edifices: and some of these fonts, which were afterwards introduced into churches, remain to this day splendid ornaments of the cathedral churches of England and of the continent.

BAPTISTS, a body of protestant dissenters, who are mentioned in ecclesiastical history under various designations, borrowed either from the names of their respective leaders, or from their peculiar tenets with regard to the subject and mode of baptism. But that of anabaptists, by which they have been most generally known, both in Britain and on the continent, they now consider as a term of reproach, and think that, in fairness, it should no longer be applied to them as their appropriate appellation.

Historians are not agreed as to the period from which the baptists date their origin; some tracing it to the *sixteenth*, some to the *twelfth*, and some even to the *first* century of the Christian era. It seems certain, however, that they had no existence as a sect before they separated from the Lutherans in Germany about the time of the Reformation. During the struggles for religious liberty in that country, several of them came over to England, where they propagated their opinions, and where, according to Messrs Bogue and Bennet, they broke off from the independents in 1608, and constituted themselves a distinct congregation. From the reign of Henry VIII. inclusive, to that of James II. who issued a proclamation of indulgence to all non-conformists, they were, with little intermission, subjected to imprisonment, banishment, and death. In 1620 many of them emigrated into New England, where, notwithstanding the opposition with which they had to contend on their first settlement, they have so amazingly increased, that, by a late computation, they are estimated at 255,670 members in the United States alone. The earliest baptist society in Scotland, it would appear, was composed of soldiers in Cromwell's army; but it was not until 1765 that this denomination of Christians assumed in North Britain an organised and permanent form. Their success since has been very considerable; they amounted some years ago to 15 churches, besides smaller associations, and their number has been recently augmented by the accession of a few congregations, from what has been called the tabernacle connexion.

The baptists maintain, that there is neither precept nor example in the New Testament to warrant the baptism of any but such as have previously professed their faith in Christ. And indeed they consider this restriction as obviously implied in our Lord's commission to his apostles: "Go ye into all the world, and preach the gospel to every creature: he that believeth and is baptised shall be saved." Hence they conclude, that as infants are incapable of exercising the principle which is here required, they are altogether unfit for receiving the ordinance; and this conclusion, they think, is corroborated by the universal practice of the primitive church. Nor can this ordinance, they contend, be duly administered, without the immersion of the *whole* body, a truth which, they allege, is clearly established by the usage of the first Christians, and by the proper and literal meaning of the original term which expresses the action. Formerly they baptised their candidates in lakes, rivers,

&c. but now they generally employ baptisteries for the purpose. The Mennonites in Pennsylvania differ from most of the British and foreign baptists with regard to the *mode* of baptism; for although they admit none but adults to this privilege, they perform the rite while the person is in a kneeling posture, by the affusion of water on his head.

In the constitution and government of their churches, the baptists are strictly *congregational;* or, in other words, each church is held to be complete in itself, and not amenable to any distinct ecclesiastical court for the management of its concerns. From a disagreement among them in reference to certain points of doctrine, they have been divided into GENERAL and PARTICULAR. Some of both classes allow of free or mixed communion, that is, they judge it lawful to sit down at the Lord's table with those who have not been baptised by immersion on the profession of their faith; and some are Sabbatarians, who observe the *seventh* day of the week, or Jewish Sabbath, although these are few in number, and confined chiefly to America.

The *general* baptists adopt the Armenian system, and hold the system of general redemption. They are distinguished into what are termed the Old and the New Connexion: those of the former have, by verging towards Socinianism, greatly diminished; whereas those of the latter, who adhere to the principles on which they set out, are in a more flourishing condition, having about *seventy* churches in England. The *Particular* baptists, who again embrace the doctrine of particular redemption, and indeed all the articles of the Calvinistic Creed, are by far the most numerous, both at home and abroad. In 1798, they had, according to Dr Rippon, 445 congregations in England and Wales.

Among the SCOTTISH BAPTISTS, such of the brethren as are deemed qualified are requested to pray and exhort. But, in distinction from these, they have a plurality of elders in each church, whose peculiar province it is to labour in word and doctrine, and to preside in all cases of discipline, which, however, are not decided without the consent of the whole society. Every Lord's day they administer the sacrament of the supper, and contribute to the support of the poor. The inspired volume is the only standard of faith and practice which they acknowledge; and they receive none into their communion who does not so understand the doctrines which it unfolds, as, in all essential points, to enter into the views which they entertain. Considering mutual affection as a distinguishing badge of the Christian profession, they, on some occasions, express this sentiment by love-feasts, and the kiss of charity. Some diversity of opinion has arisen among the Scotch Baptists on various points of doctrine and discipline, in consequence of which, some churches are separate and independent, and hold no fellowship with each other, or with their parent institutions. Some begin to think that the Lord's Supper is not exclusively a church ordinance, and that it may be dispensed by two or three persons in private, none of whom is invested with the pastoral office.

BAR SUR ORNAIN, formerly Bar le Duc, is the principal town of the department of the Meuse in France, and includes a population of 8000. The trade in wood, wines of an excellent quality, and hemp, is considerable, and is greatly facilitated by means of water-carriage to Paris.

BARATIERE, PHILIP, an extraordinary example of the early evolution of the intellectual powers, was the son of the minister of the French church at Swobach, near Nuremberg, and was born in 1725. In his fourth year he could converse in Latin, French, and High Dutch; and before he had reached his sixth year he was qualified to read the Old and New Testament in Greek, and at the same time had made some progress in the Hebrew language. The perusal of the Greek fathers and the Rabbinical writers occupied much of his time when he was only ten years of age; but between that period and his fifteenth year, his attention was occasionally directed to physical investigations; particularly to astronomy, and a method of discovering the longitude, which was communicated to some learned societies. To the liberality of the Margrave of Brandenburg-Anspach he was indebted for a pension and the use of his library; and to the university of Halle for the honorary degree of master of arts. During the remaining part of his short life, he was alternately engaged in metaphysical inquiries, antiquarian researches, and experimental philosophy. But this intellectual prodigy was connected with a feeble frame, which severe study had in no small degree contributed to exhaust and undermine before he had completed his twentieth year. He died in 1740.

BARBADOES, an island of the West Indies belonging to Britain, and the most easterly of all the Caribbæan islands, lies in north latitude 13° 10′, and west longitude 57°, is about 25 miles in length and 14 miles in breadth, and includes an area of nearly 105,000 acres. The surface of this island is not greatly diversified with hills and vallies; it is watered with several small streams, and has some springs of good water; but the supply seems not sufficient to preclude the use of reservoirs for collecting the rain water. The temperature of Barbadoes is pretty uniform, and the climate is found to be more salubrious than most of the West India islands. The soil, reposing on calcareous strata, containing animal remains, is various,—as black mould, reckoned the richest and most productive,—a whitish grey mould, in which clay predominates,—and a reddish earth, which is considered of inferior quality.

The first discovery of Barbadoes is ascribed to the Portuguese; it was then uninhabited, and they attempted no settlement. It was visited by an English ship early in the 17th century; but no permanent settlement was made till 1624, when a few adventurers from England established themselves, and, during the civil wars which soon after distracted the kingdom, received a great accession to their numbers,—so great indeed that, in 1676, it is said that the white population was 50,000, and that of the slaves amounted to 100,000; but this is undoubtedly a most erroneous statement.

The white inhabitants, in 1786, were numbered at 16,167, and the slaves at 62,953; but the latter were estimated, in 1753, at neary 70,000. In 1811, the whole population was stated as follows: Whites

Barbarossa. 15,794; free persons of colour 2613; and slaves 69,132, making the total amount equal to 87,539. Barbadoes is divided into eleven parishes; and Bridgetown, Charlestown, St James's, and Speights, are the only towns of the island. Bridgetown is the capital, and the seat of government. The political constitution of the island, with some slight deviations, is analagous to that of the other British West India colonies. Beside the established clergymen of the church of England in each parish, the Methodists and Moravians have small congregations, chiefly composed of negroes; and the congregation of Jews, in 1811, amounted to about one hundred persons.

The soil and climate of Barbadoes are favourable to the growth of all the plants of tropical regions. But sugar, rum, ginger, cotton, and aloes, may be regarded as the staple vegetable productions, and constitute the principal exports of the island. In 1736, the crop of sugar was estimated at 19,000 hogsheads; in 1789 and 1790, it was reduced to 9000 and 10,000 hogsheads; but, in 1792, the exports from Barbadoes were, of sugar 17,000 hogsheads, of rum more than 5064 puncheons, of ginger 3046 bags, and of cotton 974,178 pounds, beside aloes. The total value of the exports, in 1787, exceeded L.539,000 Sterling. The imports from Britain, the British colonies, and the United States, consist of corn, flour, rice, salt beef and pork, butter, live-stock, timber, shingles, and staves.

Barbadoes has been visited with some severe calamities. Bridgetown was twice nearly consumed by destructive fires; and it had scarcely recovered from the effects of these terrible disasters, when a tremendous hurricane, in 1780, laid waste the island, rendered the capital a melancholy scene of desolation, and destroyed more than 4000 of the inhabitants, blacks and whites inclusive.

BARBAROSSA, Aruch, a celebrated corsair, who, from the humble station of the son of a potter in the Isle of Lesbos, rose to the sovereignty of Algiers, was born between 1470 and 1480; at the early age of thirteen joined a body of pirates, and in a short time so distinguished himself by his valour and enterprise that he was entrusted with the command of a fleet of twelve gallies and some smaller vessels, while his brother Hayradin was second in command. The appellation *Barbarossa* was derived from the redness of his beard. With this powerful armament they struck terror throughout the Mediterranean, and, in the insolence of their might, declared themselves the *friends of the sea, and the enemies of all who sailed upon it.* The King of Algiers applied to them for assistance against the Spaniards; and Aruch, the elder brother, having conducted 5000 men to Algiers, was received as a deliverer; but his ambition was tempted with the prospect of sovereign authority,—he murdered the king, and seized the sceptre. To this usurped dominion he soon after added the conquest of Tremecen. But the dread of his power, and the extent of his piracies, called forth the interference of the Emperor Charles V. who dispatched a body of troops to Africa, to dispossess him of his territory, in defence of which he was defeated and slain.

The affairs of Europe at this time sufficiently occupied the resources of the Spaniards, and thus left Hayradin to enter into the undisturbed possession of his brother's throne. He assumed the same name, extended his conquests, placed his dominions under the protection of the Grand Signior, Solyman the Magnificent, and obtained the command of the Turkish fleet. By artifice, and the murder of the young prince of Tunis, he succeeded in adding that state to his dominions; and after various exploits on the coasts of the Mediterranean, he died in 1547. Robertson's *History of Charles V.*

Barbary. BARBARY, or Barbary States, is the modern name of a large Mahometan country on the north coast of Africa, extending from the Atlantic ocean to the confines of Egypt, and comprehending the independent districts or states of Morocco and Fez, Algiers, Tunis, and Tripoli, together with a considerable, but little known tract between them and the great desert of Sahara. It stretches from the 10° W. to the 26° E. longitude, being about 2000 miles long, and from the 26° to the 37° N. latitude, of very irregular breadth. The Mediterranean sea forms its northern boundary. An almost perfect identity of climate, the similarity of vegetable and animal productions, and a striking correspondence in the features, manners, and institutions of the various inhabitants, properly constitute this one region; nor do the historical or political differences, by which the respective governments may be distinguished, claim any peculiar attention from the general reader.

Climate and seasons.—The climate, on the whole, is temperate, considering the geographical position; the vicinity of the Atlantic ocean and Mediterranean sea contributing powerfully, it is probable, to moderate the tendency to excessive heat. Rain is frequent during the winter months; less copious during spring; and rarely seen in summer, which is consequently both unpleasantly hot and often productive of very formidable diseases. Towards the end of August, in general, the temperature of the atmosphere becomes more moderate, and gradually falls during the succeeding autumn, which ends about November, when the winter, or rainy season, commences. In this last period, the mornings are usually sharp, and frost and snow are occasionally experienced; but these approaches towards cold are rarely either so rapid or so long continued as to compel the inhabitants to have recourse to artificial heat. The easterly winds, which prevail from May to September, are commonly dry, though the atmosphere be cloudy; westerly and northerly winds blow violently in March, and are loaded with moisture, which falls in showers during the intervals of the gales; the south and south-west winds of summer aggravate its evils by diffusing the noisome product of the sun-burnt desert.

Soil and vegetation.—The soil, like that of the African continent in general, is of a light, sandy consistence, so as to be very easily worked, which peculiarly suits the indolent habits of the people. The abundance of small streams which issue from the mountains, traversing the country, secures an amazing degree of fertility. A richer mould is met with in some of the vallies which divide the ridges of hills;

Barbary.

and in them, accordingly, vegetation is still more powerful and varied. In these happy spots are found some of the most delicious fruits and flowers; the pomegranate, the orange, the olive, the date-palm, the pistachia, the jasmine, the oleander, the white musk-rose, the bay, the myrtle, &c. Like the heathy districts of Spain, many of the rocky intervals between the vallies abound in cork-trees and oaks, under whose protection the luxuriance of nature has displayed itself in the production of lavender, sage, and many other aromatics. The arborescent broom, various species of cistus, the aloe, the sumach, the mignonette, of a large size, and probably perennial, several sorts of euphorbia and cactus, and many other plants, which are capable of heat and drought, ornament some of the rocky tracts, and yield nourishment and shelter to the wild goats which inhabit them. The moist and low lands have their full share of appropriate vegetation, saline succulent species, and bulbous rooted plants, a profusion of grasses, &c. Wheat and barley are a good deal cultivated; oats are less common, beans and lentils are abundant, as are also pot-herbs of such kinds as are usual in European countries.

Mountains and mineralogy.—The chief mountain range in this country has received the name of Atlas from classical times. It is nearly co-extensive with the length of Barbary, but is most elevated towards the western extremity, in part of which the height is said to be upwards of 13,000 feet above the level of the sea. Some of the eminences are almost perpetually covered with snow; the lower regions are either ornamented by natural vegetation, in the form of forests and a variety of shrubs, or are considered well worthy of cultivation from the richness of the soil. This Atlantæan chain is nearly intermediate between the plain of the Barbary states or the coast of the Mediterranean sea, and the sandy desert. A smaller range of mountains, still nearer the former, extends from the straits of Gibraltar to the boundary between Algiers and Tunis. The mineralogical constitution of these hills is very little known. It is conceived, that the chief elevations are of the primitive or first order of rocks; and according to Ali Bey, one of the latest travellers in this country, the rocks towards the coast are of granite, with superimposed sandstone. Marble and other calcareous strata are abundantly distributed through certain parts of the country. The metals are not plentiful, or, more correctly speaking, through the carelessness of the people, have not yet been discovered to any great amount. It is perfectly certain, that both gold and silver are to be met with in some districts; but the absurd policy of the sovereigns, particulary those of Morocco, has hitherto prevented the necessary mining operations.

The *rivers* of this region are numerous rather than large, the peculiarity of the country, and the shortness of the distance they have to run towards the ocean, rendering their junctions few and unimportant. The Malub, Malva, or Muluvia, one of the most considerable, divides Morocco from Algiers, which again is watered by the Shellif. This rises on the northern side of the Atlas, and runs in a westerly direction to the Mediterranean. It is the Chinala of antiquity. The chief river of Tunis is the Mejerda, in former times the Bagrada. Tripoli, which lies towards the east of Tunis, in consequence apparently of the diminished size of the mountains, or rather their total disappearance on the frontiers of Algiers and Tunis, is destitute of any river of note. Several lakes and marshes, with some curious saline and mineral springs, are interspersed through the country. The abundance of saline substances is manifested by the fact of the banks and beds of many of the rivers and lakes being encrusted with them during the summer months.

Barbary.

Animals—The zoology of this region is somewhat interesting. Of the larger quadrupeds, we find the panther, hyæna, wild-boar, and lion. The antelope, so noted for swiftness, is hunted, as well for the excellence of his flesh, as for the pleasure of the chace. Camels, horses, asses, cows, sheep, and goats, are all domesticated. The cattle are said to be small and slender; and the horses have degenerated from their long-boasted excellence. In some places the sheep are as tall as fallow-deer, but generally they do not attain to a great size. Among birds, the ostrich and stork are mentioned as numerous. The feathers of the former constitute a valuable commercial commodity. Game of various kinds is plentiful in Morocco, where also fowls and pigeons are abundant; but ducks are rare, and geese and turkeys unknown. Serpents exist of several species, and in great numbers. The gigantic *boa constrictor* is far from being a rare visitor of this region. It was to this species, no doubt, that enormous creature belonged, which appalled the whole army of Regulus on the banks of the Bagrada, and which, according to Pliny, was an hundred and twenty feet long. Specimens measuring thirty feet and more are not of rare occurrence in the museums of European naturalists. All the wild beasts together do not occasion so much mischief as one insect, the locust. This is properly a native of the desert, which, however, it is impelled, for some hitherto unexplained reason, to abandon at certain intervals, when it seeks those parts of the neighbouring countries where its food is to be had. Vegetation of every kind, notwithstanding the employment of all possible modes of annoyance and defence on the part of the inhabitants, is absolutely, and in an amazingly short time, consumed by the myriads of these insects on their portentous visitations. It is some consolation, in so grievous a calamity, that the locust itself presents a very palatable nourishment.

People—The inhabitants of Barbary are of several distinct races, of which the *Moors* are most numerous. These appear to be a mixed race descended from the ancient *Mauri*, as the name imports, but blended with the progeny of other people. They generally dwell in the cities of the coast, but are often found in places far inland, where they subsist on their flocks, and the produce of their wretched agriculture. The former usually carry on some trade, and have attained to no very contemptible degree of refinement in manners; but their propensity to pleasure, to jealousy and revenge, their superstition, ignorance, indolence and family pride, with an amazing gravity of deportment, are still more conspicuous features. The women, as is usual in Mahometan countries, where they are considered as merely subservient to the inclinations and caprices of the other sex, are cautiously secreted from public notice in the harams of their lords and masters. Each man is permitted to have four wives, and as many concubines. One of the wives is always superior to the rest, and is entitled to a display of authority and consequence to which none of the others can lay claim. Their days are not altogether consumed in silly gossip, the toil of decorating their persons, or administering to sensual enjoyments, as has often been imagined. On the contrary, they have various domestic duties to perform, and occasionally exhibit an industry and maternal solicitude which would honour the sex in any country.

The *Brebers*, *Berebbers*, or *Barbars*, from whom this region has been named, are dispersed over the whole country, of which, notwithstanding their misfortunes, and the repeated, or rather unintermitting attempts to subject them to the Moorish yoke, they consider themselves the proper owners. They are probably, indeed, the offspring of the original possessors, and have spirit and inclination enough, though they do not at present enjoy all the other requisite means, for realizing their pretensions. Their language is of high antiquity, and differs from all the other dialects spoken in this region; but its nature and connexions are not well understood. They are governed by their own chiefs, and still contrive to maintain a sullen and somewhat ominous independence in the fastnesses and obscurities of the mountains. The *Shelluhs* inhabiting the southern parts of Morocco, are in many respects similar to the Brebers, of whom they are, perhaps, a merely incidental branch.

Jews abound in Barbary, where, as usual in other countries, they addict themselves almost exclusively to the art of making money, and where, as was formerly the case throughout the whole of Europe, they pay dearly for their privilege and acquisitions, by inheriting universal contempt, and being perpetually liable to the most vexatious injustice and rapacity. By a very natural reaction of feeling, they become selfish, hypocritical, and cunning. Of late years, it is said, the number of Jews has greatly diminished, their fortitude and love of gain very probably giving way to such enormous oppression as they experienced.

The characteristics of the *Arab* are modified by the despotic nature of the governments established in Barbary, and probably by occasional intercourse with other people. But the change unfortunately is not to the better. Their almost chivalrous love of rapine has dwindled into contemptible thievishness; their courage, no longer secure and even honourable in its heroism, seeks the protection of night and of numbers; their sense of independence, in place of its former dignity, assumes a brutal ferociousness of manner; and a hospitality of conduct, which either obviated or redeemed their original vices, has been nearly totally immersed in the unmercifulness of religious bigotry.

The *Turks* resident in Barbary are noted for their idleness, indolence, and general depravity. A race of *negroes*, originally derived from the interior of Africa, and augmenting, in Morocco particularly, by the encouragement of the government, which employs it in its armies, is rapidly rising into distinction, and promises ere long to effect some important political changes.

It is almost unnecessary to mention, that the *Christians* who had the misfortune to reside in this country, were, with very inconsiderable exceptions, doomed to slavery, from which there was scarcely a possibility of being redeemed but by the renunciation of their religion, or the payment of exorbitant ransoms by their relatives. This reproach, it is hoped, under which Europe was for so many centuries degraded, has for ever been wiped away by the late vindictive and successful interference of our own country.

States.—Morocco, including *Fez*, has been nominally an empire since the fourteenth century. It is the most westerly, and the largest of the Barbary states. Judicious policy, and a liberal intercourse with foreign powers, are all that are wanting to secure its welfare and consequence. A population amounting, according to Mr Jackson, to upwards of 14 millions, and possessing the highest advantages of position and natural resources, must be ill guided, indeed, to have proved so ineffective in the drama of the western world. Its commerce has greatly declined through the absurd measures of the present emperor, Muley Soliman, who is nevertheless one of the most sensible and moderate sovereigns which Morocco has ever enjoyed. Mogadore is now the chief port. The principal cities are, Morocco, Fez, Mequinez, Tangier, and Sallee.

Algiers is next in rank and situation to Morocco. Its population, which is variously and very uncertainly reported, probably exceeds five millions. The famous Barbarossa seized this government about the commencement of the 16th century, sheltering himself under the protection of the Grand Signior, who henceforth became the nominal sovereign, but who, in reality, for a long time has possessed neither power nor influence in Algiers. Since that period, this state has been almost perpetually engaged in piracy, and has often excited the indignation of the European countries, all of whom, at some time or other, have suffered from a grievance which any one of them almost might singly have annihilated, had there existed no suspicion or conviction that the rest would interfere. Yet it is remarkable, that the expeditions which the superior means of the larger governments, at the times of their political ascendancy, enabled them to send against these robbers, have generally failed in immediately inflicting adequate retribution, and always in preventing a renewal of the atrocities complained of. Whatever success did attend these undertakings, was recompensed by a merely temporary exemption of the individual from the aggressions which occasioned them. This freedom, again, has been often purchased by vile compliances and degrading tribute; nor is there, perhaps, a single maritime state in Europe, capable *by any means* of obtaining a *safe-conduct*, which has not witnessed its neighbours exposed to pillage and captivity, with a malignant and dastardly satisfaction at its own escape. The recent conduct of Britain establishes her title to the championship of humanity and civilization;

and the 27th of August 1816 will ever be blazoned as the day of their triumph, through the bravery and good conduct of her sailors. But it is neither unmanly nor ungenerous to doubt, whether the enterprize of one day, however judicious and energetic, have broken the habits of ages, or determined a nation of ruffians to imitate the virtues by which they were overcome. Algiers is divided into provinces, in which particular it differs from Tunis, the state next to be mentioned. The chief of the government, which is a strict despotism, is denominated Dey, who generally resides in the town of Algiers. His revenue has been said to exceed L.120,000 a-year. He can bring into the field an army of more than L.50,000 men; but they are badly trained, and unless infuriated by religious hatred, can scarcely be said to possess any of the qualities of soldiers.

Tunis, which lies to the east of Algiers, is neither so large nor so populous, but it is probably better cultivated, and on the whole the inhabitants have more refinement, and greater liberality of disposition. These two states frequently carry on hostilities with each other; but their warfare is rather of a ludicrous nature, and seldom occasions bloodshed, a mutual and highly operative dislike to hard blows commonly preserving a very expedient distance between them. The troops of both, however, are astonishingly expert in pillaging the undefended, and "slaying the slain." Their dexterity in these valourous arts is on the whole so equal, that no advantage remains long with either party; and as success is consequently pretty regularly alternate, and of course always merits rejoicing, it seems that their rencontres are very conducive to social happiness! The sovereign of Tunis is called Bey, and acknowledges the Grand Signior as his superior.

Tripoli is a still smaller state, of which less information is possessed by Europeans than of any other in this region. It has long been almost altogether under Turkish government, a sufficient reason for its inferiority and obscure condition; but a late bashaw, as its chief is styled, partly threw off the yoke, and adopted some judicious measures, which might have ensured prosperity had his successor profited by his example.

BARBER, from *barba* the beard; a person whose profession it is to shave the beard of others. Several centuries elapsed before barbers were known in Rome as a separate trade; and when the constitution of civil society began to be settled and improved in Europe, it appears that they were united with the corporation of surgeons in most countries. The practice which barbers had acquired in handling delicate instruments probably led to this union. The barbers of London were incorporated with the surgeons in the time of Henry VIII.; and it was not till the reign of George II. that the separation took place. The origin and meaning of the barber's pole, a white staff, ornamented with a coloured spiral band, have been the subject of much discussion. The most natural explanation seems to be, that it alludes to the surgical department of the united profession, that the pole is a representation of the staff grasped by the patient in blood-letting to increase the flow of blood by the action of the muscles, and the band denotes the ribband or fillet for binding up the arm.

BARBOUR, John, one of the earliest Scottish poets, flourished in the 14th century, and died near its close in 1396. He seems to have been a person of some consideration; he was archdeacon of Aberdeen; was engaged in important missions to England and France; and had a pension from government, either for his public services or as a reward for his literary labours. The only production which has transmitted his name to posterity is a historical poem, entitled, "The Acts and Life of the most victorious Conqueror Robert Bruce, king of Scotland," &c.; the best edition of which was published in 1790, in 3 vols. 8vo.

BARBUDA, one of the Caribbee islands in the West Indies, about 20 miles long and twelve miles broad, contains a population of nearly 1500, and supplies the neighbouring islands with live-stock and Indian corn, for the rearing and culture of which the soil seems best suited.

BARCA, an extensive region of Africa, which stretches along the shores of the Mediterranean from the confines of Egypt to the territory of Tripoli, and is bounded on the south by the Sahara or Great Desert. Excepting a few spots near the towns and villages, where the verdure of vegetation appears, the whole of this immense tract is a barren, sandy waste, without water, and without the means of cultivation. These verdant spots are called *oases* or islands. Of the interior of Barca little is known. The natives of the maritime towns, in their general character, resemble the inhabitants of Barbary. They profess the Mahometan religion; regard themselves under the protection of the Porte; but are tributary to the bashaw of Egypt or Tripoli. The inland districts are inhabited by wandering tribes of Arabs, who live chiefly by plunder. Millet, maize, or Indian corn, and dates, are the only vegetable productions which occupy the industry of the inhabitants on the fertile spots. Brown's *Travels*. Horneman's *Travels in Africa*.

BARCELONA, the capital of the province of Catalonia in Spain, stands on a fertile plain encompassed on one side by hills and bounded by the Mediterranean on the other. Few cities can boast of higher antiquity; it traces its origin to the Carthaginians, 250 years before the Christian era; and having successively acknowledged the authority of the Romans, the Goths, and the Moors, after a tedious and disastrous siege of seventeen months, yielded to the French arms in the beginning of the 9th century. But in the year 985 it was taken by the Moors, who destroyed the city by fire, and doomed a large proportion of the inhabitants to slavery. After this period of its history, Barcelona has been the scene of many severe struggles during the political revolutions of Spain and of Europe; but in 1714, when it refused to join in the allegiance to Philip the Fifth, declared by Catalonia and the contiguous provinces, in consequence of the treaty of Utrecht, in the preceding year, it sustained one of the most memorable sieges recorded in history.

Barcelona is strongly fortified with walls, furnished with numerous bastions, a citadel and a fort on an elevated spot. The ramparts form a spacious terrace, which commands a fine view of the town and surrounding territory. The streets are generally narrow and irregular, yet some of them are spacious and elegant; many of the public buildings are fine edifices, and the cathedral is a magnificent structure. Barcelona had once a university, which has been suppressed; and four academies, in which natural philosophy, history, jurisprudence, are taught, are its only institutions for literature and science. The harbour is spacious and well sheltered, and admits, sometimes, more than a thousand vessels in the course of a year. A bar, formed by the rivers Bezos and Llobregat, where they discharge their waters into the sea, renders the approach to the harbour difficult, and sometimes not altogether free from danger.

The population of Barcelona, including Barcelonetta, a new town in its vicinity, was estimated in 1806 at 160,000. Manufactures have long flourished; and printed cottons, silks, satins, velvet, lace, gold and silver embroideries, stained-paper, hat-making, glass-making, and a foundery for cannon, give extensive employment to the inhabitants. More than 10,000 persons are occupied in spinning and weaving cotton, which commenced about the year 1790. The trade of Barcelona is extensive and lucrative, and no town in Spain enjoys more commercial intercourse with the different states of Europe and with the Spanish colonies in America. Its annual value has been stated at the enormous sum of a million and a half Sterling.

Some beautiful remains of Roman antiquity are still visible; among which are enumerated part of a Mosaic pavement, composed of white and blue stones, representing tritons and fishes; a magnificent arch of an aquæduct; a white marble basin elegantly sculptured; six massy fluted columns with Corinthian capitals; and a small statue of Bacchus, of exquisite workmanship. Laborde's *Spain*, Vol. I.

BARCLAY, John, a literary character of considerable eminence in the beginning of the 17th century, was born in France about the year 1582. His father, a native of Aberdeenshire in Scotland, had resided long in France, and was professor of civil law in the university of Angers. It would appear that he had been educated among the Jesuits, for he was strongly urged to enter into that order; but his father resisted their solicitations, and, about the time of the accession of James I. to the throne of England, he brought him to that country, where he composed and published a Latin poem on the king's coronation. From this time, London, Paris, and Rome, where he died in 1621, were at different times the place of his residence. He was the author of various works; but he is best known by the *Argenis*, a kind of political romance, which is greatly distinguished by the elegance of its Latinity.

BARCLAY, Robert, the celebrated author of the *Apology* for the Quakers, was born in 1648, and descended from the family of Ury in Aberdeenshire, which could trace a line of ancestry for several centuries. His education was conducted partly in his native country, and partly at the Scots college in Paris, in which his uncle held the place of rector, where he gave early proofs of the superiority of his intellectual powers, and especially of that acuteness of judgment and promptitude of reply so requisite in the public disputations, which formed a considerable part of the prevailing system of tuition.

The dread which his mother entertained of his conversion to the church of Rome occasioned his recal to Scotland; a short time only elapsed when he joined the society of Quakers; and not long afterwards he appeared as an author in defence of the system and society which he had adopted. Beside other works, an exposition of the principles of the society, under the title of *A Catechism and Confession of Faith*, appeared in 1673, and was soon followed by his *Theses Theologicæ*, or "Theological Propositions."

About the year 1676, he accompanied the celebrated William Penn, the proprietor and settler of the province of Pennsylvania in North America, in a tour through England, Holland, and Germany; and in the same year the *Apology for true Christian Divinity*, written in Latin, was published at Amsterdam, was soon afterwards translated into six different languages, and obtained a very extensive circulation, while it became the subject of much controversial discussion. Towards the close of this year, after his return to Scotland, he suffered five months imprisonment at Aberdeen, along with other members of the society, in consequence of the severe edicts of the times against non-conformists. The remaining part of his life was occupied in frequent journies to England on the concerns of the society; he was much in favour with Charles II. and his successor the Duke of York, and was frequently admitted to personal, and seemingly familiar, conferences with both monarchs. The commission which he had received, as governor of East Jersey in America, was confirmed to him by the former for life, with power to appoint a deputy to discharge the duties of the office. During his last visit to London, in November 1688, a period so fatal to the fortunes of James II. he had a friendly interview with that misguided monarch on the eve of his exile. Having spent two years of retirement at his patrimonial residence, and after attending a meeting of the society at Aberdeen, he was seized with a fever on his return to Ury, and died in October 1690.

Robert Barclay possessed a vigorous and active mind, which was highly improved by the regular discipline of a classical education. His numerous works bear undoubted marks of deep and careful research, and of various and extensive learning; and the equanimity of his temper, the vivacity of his disposition, and the benevolence of his heart, were not less conspicuous than his powerful intellectual acquirements.

BARD, which is said to be derived from a British or Celtic word, and signifies a *singer*, was a poet and musician by profession, in ancient times, who celebrated the heroic deeds of his countrymen, or poured forth the wail of lamentation when disaster befel the warrior or the nation. In those periods of society which precede the knowledge of letters and the art of writing, bards are to be regarded as the traditionary historians of the age; and hence it appears that, among all nations, those who were qualified to devote themselves to the profession were liberally supported and warmly cherished. The requisite talents to attain excellence in the art, a musical voice and ear, skill in instrumental music, and a genius for poetry, are seldom united in the same individual; so that he who was possessed of the rare assemblage of the powers of music and of song could not fail to share largely in the esteem and regard of his admiring countrymen.

The early history of all nations alludes to bards; they were common among the Greeks in the days of Hesiod; Homer refers to persons of the same profession; and at the feasts of the ancient Romans they were employed to celebrate the achievements of their heroes and great men. Even among the ruder nations of modern times, as among the natives of Mexico and Peru, the bards sing the praises of their chiefs and warriors. But in no nation has this profession assumed so regular and systematic a form as among the Gauls or Celtic tribes. The institution of druids and of bards was equally regarded as an essential part of their manners and policy. The first were the philosophers of the age and the priests of religion; and it was the business of the last to recite and record the deeds of heroism and of fame, to be transmitted in song to future times.

A numerous band of bards was kept in the train of kings, princes, and great men. They were divided into classes and orders. To the chief bard was assigned a certain number of inferior character; and even the latter were attended by others still less distinguished than themselves. In Ireland, Wales, and the Highlands of Scotland, the bards, from obvious causes, flourished longer than in any other part of the British dominions; but as civilization advanced, and letters were cultivated, they gradually degenerated into the less respected profession of harpers and minstrels; and in Wales, in the time of Queen Elizabeth, they had become so numerous and burdensome to the inhabitants, that the interference of the legislature was required, and a statute was expressly enacted for their regulation and partial suppression. Warton's *History of English Poetry*. Blair's *Dissertation* prefixed to *Ossian's Poems*.

BAREGES, a village in the department of the Upper Pyrenees in France, famous for its hot springs, which have long attracted crowds for the purpose of drinking and bathing. The village consists of a single street of indifferent houses; and some years ago no inn for the accommodation of the traveller had been established. The surrounding mountains, which are composed of primitive rocks, are clothed with verdure to their summits; but no woods break the dull uniformity of their aspect. The mountain strawberry is so abundant, that during the summer months, it furnishes an essential and an agreeable part of the dessert at the tables of the visitors.

The waters of Bareges have their origin in several sources, varying in temperature from 94° to 114° Fahrenheit, and commodiously distributed into four separate baths; they are quite limpid when they are received into the bathing troughs, and are of a sulphureous and saline quality. Muirhead's *Travels*, p. 302.

BAREITH, a city of Franconia in Germany. See BAYREUTH.

BARFLEUR, a town of Normandy, now the department of the Channel in France, famous as the seaport from which William the Conqueror sailed when he invaded England. The Cape of the same name is 12 miles east of Cherburg.

BARI, a province of Naples, which includes a square area of nearly 700,000 acres, and a population exceeding 280,000, and produces corn, saffron, fruits, and cotton. Bari, the ancient *Barium*, is a sea-port town on the shores of the Adriatic. The number of inhabitants is vaguely stated by different travellers from 6000 to 30,000, who are occupied chiefly in the manufacture of glass, cotton, and linen, and fishing. Bari is 120 miles north-east from Naples.

BARILLA, sometimes signifying the plant from which the soda of commerce is obtained, but more commonly the alkali itself, is extensively cultivated on the salt-marshes of Spain which stretch along the shores of the Mediterranean. The preparation of the barilla, or soda, is conducted nearly in the same way as the kelp manufacture of this country.

BARK, the external covering of trees, which is of very extensive use in the arts, as the bark of the oak employed in tanning, of the alder and walnut tree in dyeing, of the cinnamon tree in spicery, of the cinchona or Peruvian bark tree in medicine, and of a species of oak for corks. Ropes, cloth, and paper, are also manufactured from the bark of different trees, examples of which are well known in the curious fabrics of the South sea islanders.

BARLEY, the English name of the genus *hordeum*, several species of which are objects of culture. See AGRICULTURE.

BARNES, JOSHUA, a learned critic and editor, was born in London in 1654, educated at Cambridge, was elected a fellow of his college, and appointed professor of Greek in the same university. Before he had reached his 17th year, he appeared as the author of a collection of Latin and English poems. But he was more distinguished as an editor; and the works of Euripides, Anacreon, and Homer, were successively the subjects of his learned labour and critical skill, and are still valued by classical scholars. He died in 1712.

BARNSLEY, a town of the West Riding of Yorkshire in England, with a population approaching to 4000. Iron wire, nails, and various kinds of hardware, cloths and glass, are thriving manufactures, which the abundance of coal, iron ore, and timber in the surrounding country, and the advantage of inland navigation, have greatly improved and extended.

BARNSTAPLE, a sea-port town of Devonshire in England, stands in a fine vale on the banks of the Taw, is noted for its manufactures of baize, silk stockings, and waistcoat pieces, and had formerly some trade; but the approach to the harbour is greatly impeded by sand banks. Barnstaple was once defended by walls and a castle. The population in 1801 amounted to 3748.

BAROMETER, from two Greek words signifying *weight* and *measure*, is an instrument for measuring the weight or pressure of the atmosphere; and as it distinctly indicates the changes that take place in the weight of that elastic fluid, the coincident changes of the weather being observed, this instrument has been employed to denote those changes, and in this application is well known under the name of the *weather-glass*. The barometer is also in use for ascertaining the height of mountains, on the principle, that the higher in the atmosphere the instrument is carried, the pressure is proportionally diminished, by the action of a shorter column of air. For the principles of its construction and application, see METEOROLOGY and PNEUMATICS.

BARON, a title of rank applied to a person who holds a barony, or who possesses the right, by letters patent, of being a member of the House of Lords. See RANKS, *Distinction* of, under HERALDRY.

BARONET, a title or dignity next to that of a baron, and taking precedence of all knights, excepting knights of the garter and knights-bannerets. The order of knights-baronets was instituted in 1611 by James I. and the number was then limited to 200, but has been since indefinitely extended at the king's pleasure. See RANKS, *Distinction* of, under HERALDRY.

BARONETS of Scotland, or of Nova Scotia, was an institution proposed by James I. but not completed till 1625, in the time of his successor, for the express purpose of encouraging the settlement and cultivation of Acadia, or New Scotland, in North America, which was occupied by the English. To each adventurer a portion of land, with many privileges, was granted. See RANKS, under HERALDRY.

The institution of the order of baronets in Ireland, with privileges similar to those in England, took place in the 18th year of the reign of the same monarch.

BARRA, a district or kingdom on the banks of the Gambia in Africa, is said to be extremely populous, and chiefly inhabited by that race of negroes called Mandingos. Previously to the abolition of the slave-trade, this part of Africa supplied the West Indian colonies with great numbers of slaves. The Mahometan faith prevails; and a kind of monarchical form of government is established. But that a people in a great degree still in a savage state should be distinguished by so much prudence and moderation in their civil policy as has been described by travellers, must be ascribed to ignorance or credulity. The exaggerated statements alluded to represent the Mandingos as a wise, happy, and contented people.

The vegetable productions of warm climates are abundant; but it does not appear that much attention is bestowed on their cultivation. Salt is manufactured; the evaporation is conducted by the heat of the sun; and the produce forms a valuable commercial commodity, which is exchanged with the inhabitants of the inland parts of the country for maize, gold-dust, ivory, and cotton stuffs.

BARRA, or BARRAY, one of the Western islands of Scotland. See HEBRIDES.

BARREN ISLAND, an island in the Indian ocean, about 50 miles to the eastward of the Great Andaman, is 18 miles in circumference, and extremely conspicuous for a volcano which discharges enormous volumes of smoke, and great quantities of ignited matters, from a mountain which rises to the height of nearly 2000 feet above the level of the sea.

BARRINGTON, the Honourable DAINES, a naturalist and antiquary, was the son of Viscount Barrington. The father, who was raised to the Irish peerage in 1720, acquired some literary reputation as the author of *Miscellanea Sacra*, in which the means employed by the first preachers of the gospel in propagating Christianity are traced and examined, as well as of some other works. He was a warm friend and zealous advocate of the dissenters; and five of his sons were fortunate in attaining conspicuous stations in different departments of the state. Daines, the fourth son, was destined to the profession of the law; was appointed a Welsh Judge in 1757, and afterwards Justice of Chester, which latter he resigned in 1785, and retired to his chambers in the Inner Temple, where he died in 1800. His *Observations on the Statutes, chiefly the more ancient*, with a *Proposal for new-modelling them*, is reckoned a valuable treatise. But his *Experiments on the Singing of Birds*, and his *Essay on the Language of Birds*, published in "Miscellanies on various Subjects," in 1785, are considered the most curious and interesting of all his investigations, and are often alluded to by succeeding inquirers.

BARROLOOS, a tribe of people in southern Africa, who are said to inhabit a district ten days journey from Leetakoo, have numerous large towns, well built houses, and have made such progress in the arts as to extract iron and copper from their ores.

BARROW, Dr ISAAC, an eminent mathematician, and a learned divine, was born in London in 1630; and at Charterhouse, his first school, he gave no promise of future greatness; for an untoward temper, a slovenly habit, and obstinate idleness, were then his chief marks of distinction. But on his removal to Felsted in Essex, he was actuated by a better disposition; and the alacrity and success with which he now applied to study gave joy to his father, who, in his secret thoughts, had destined him to a learned profession; and his progress in learning was attested by his master, who appointed him classic tutor to Viscount Fairfax.

In 1645, he became a student of Trinity-college, Cambridge. Attachment to the royal cause had so ruined his father's fortune, that at college young Barrow found himself in a scene expensive beyond his means, and was glad to avail himself of the liberality of the celebrated Dr Hammond. In the course of his studies he perused the works of Bacon, Des Cartes, Galileo, and other eminent authors; and such was his reputation, that notwithstanding the unpopularity of his political opinions, he obtained a fellowship. With a view to the practice of medicine, he engaged with ardour in the study of anatomy, botany, and chemistry. But, through the advice of his uncle, bishop of St Asaph, seconded by his own views of the obligation of the oath which he had taken on becoming a fellow, he withdrew his attention from these studies, and directed it to others connected with mathematics. While he read Scaliger on Eusebius he saw that chronology depended on astronomy, and astronomy on geometry; and that his knowledge might rest on a sure foundation, he began the study of Euclid's elements, and persevered in the pursuit till he attained to eminence.

Having been disappointed in his expectation of succeeding Dr Dupart, as professor of Greek, he resolved to visit the continent. At Paris he found his father, who had followed the fortunes of the exiled Charles. From France he went to Italy, and spent some time in Florence, employed chiefly in the examination of books, manuscripts, and medals. The plague prevented him from visiting Rome. He spent a year in Greece and the adjacent countries; and read, while at Constantinople, the works of Chrysostom, whom of all the fathers he admired the most. He came home through Venice, Germany, and Holland, and hastened to enter into orders, expecting preferment on the restoration, of which, however, he was disappointed.

In 1662 he was nominated lecturer of geometry in Gresham college, London, and, not long after, declined a valuable living in the church, because it was encumbered with the education of the patron's son. In the following year he obtained, through the recommendation of Dr Wilkins, the mathematical lectureship which Mr Lucas had lately founded at Cambridge; and, to secure the object of the institution, he caused himself and his successors to be bound to leave annually ten written lectures to the university; and still more to illustrate this chair, he resigned it in favour of *Sir Isaac Newton*.

The study of theology and the composition of sermons now employed his time and exercised his talents; and in this, as in all his other pursuits, he soon rose into high excellence. In his 42d year he was made master of his college, on which the king declared that he had given a place to the best scholar in England. This was a station suited to Barrow's taste, and he sought for no higher promotion; but he did not on that account decline into idleness. He discharged the duties of his office with assiduity, added to the number of his sermons, and composed his treatise on the pope's supremacy. On the 4th of May 1677, a fever deprived the world of this ornament of mankind, who had taught them to explore the secrets of science, and to understand that wisdom that hath come from above.

As an author, Dr Barrow holds the highest rank, both in regard to the kind and the quality of his productions. He wrote poetry in Latin, on several subjects, but never indulged in satire,—"his wit was pure and peaceable." His principal works in mathematics are Euclid's Elements and Data; eighteen optical lectures, still held in high estimation; thirteen geometrical lectures, in which he treats of curve lines; some lectures composed while he was Lucasian professor. With the exception of two, his sermons are posthumous; but as he had transcribed them all several times, he left them prepared for the press. His style is nervous and bold; and his illustrations are often exuberant, combining his stores of erudition, his knowledge of scripture, and his experience of life. His language is sometimes older than his age, but it glows with the spirit of genius and piety. His admirable discourses, though long, are read without languor. He enlarges the understanding by the accuracy of his reasoning; he captivates the imagination by the splendour of his descriptions; he charms the heart by his display of the beauty of holiness. He was no less amiable as a man than great as an author. A culpable negligence of his person hurt him with those who only judge from outward appearance; but those who knew him best have borne ample testimony to his virtues; they pronounce him to be a man of strict integrity, warm benevolence, and pure piety, of great meekness of temper and gentleness of manners, an honour to his college, his country, and to human kind.

BARROWS, are artificial mounds of earth or stones, generally of a conical form, which seem to have been destined as repositories of the dead, or to commemorate some public event. They are common in many parts of the world. Such structures were well known to the ancient Greeks; and they are distinctly alluded to by Homer, as monuments reared as a tribute of regard and affection to the memory of their departed heroes. The barrow of Alyattes, father of Crœsus king of Lydia, is described by Herodotus as a vast mound of earth raised on a lofty basement of massy stones. This grand monument, which was three quarters of a mile in circumference, and 200 feet in height, was constructed by the united labour of the citizens. Similar structures of less magnitude, intended, it is conjectured, as the sepulchres of the younger branches of the royal family, are erected in its vicinity. The Grecian barrows were usually surmounted with the figures of animals, or with pillars containing inscriptions.

Monuments of this kind are not unfrequent in Britain. The urns, utensils, and warlike instruments found deposited in some of them, point out a Roman origin. But others are supposed to be the works of the Britons or Danes; and as they are more numerous in particular places, may it not be conjectured that such spots were regarded as the consecrated sepulchres of the dead, or the scene of some memorable battle. The barrows or cairns of Scotland include urns, containing burnt bones and ashes, or stone chests with the bones entire, or bones seemingly thrown together in a promiscuous manner.

Mounds of earth, or of loose stones, destined to a similar purpose, have been discovered in America, in some of which Mr Jefferson, who examined a number of them, found immense collections of human bones, which seem to have been deposited at different periods. Of the origin of the transatlantic barrows some diversity of opinion prevails. While they are supposed by some to have been the general sepulchres of great towns which once existed near the spot, others think that they are the tombs of the dead who fell in battle; and others have conjectured, that they are to be ascribed to the custom, which is said to be observed among the Indian tribes, of collecting, at certain periods, the bones of the dead into one great repository.

Mr Stackhouse, who has examined the ancient monuments of this description in the southern districts of Britain, advances another opinion of their origin and use; and supposes that they were intended for the purpose of direct and speedy communication of intelligence of the approach and movements of hostile invaders. In support of this opinion, he has traced these barrows through a considerable extent of country, and finds that they are so arranged and accommodated to the nature of the ground, and of such magnitude and height as the particular situation required, as admirably to afford the best means of uninter-

Barry. rupted communication. Gough's *Sepulchral Monuments of Great Britain*. Stackhouse's *Illustration of Ancient Barrows*. Jefferson's *Notes on Virginia*.

BARRY, JAMES, an eminent historical painter, and author, was born in Cork in 1741. His father a coasting trader, had destined him to his own perilous profession, and, with this view, he made several voyages across the British channel; but his aversion to a sailor's life was invincible; and instead of handling the ropes, and managing the sails, he was employed in sketching the coast, or drawing the figures which accident presented, or fancy chanced to suggest. Reluctantly allowed to follow the bent of his own inclination, he devoted himself entirely to the perusal of books, and the practice of drawing; and for these pursuits he abandoned all boyish amusements, neglected his sleep, and grew careless of his person. He read whatever books he could procure, took large extracts from some, and made complete copies of others: but he had most delight in drawing, in which he always aimed at a representation of action, attitude, and passion, choosing for this end historical subjects, such as Abraham's sacrifice, Daniel in the Lion's den, Susanna and the Elders, &c. At this youthful period of his life he is also said to have furnished a bookseller with drawings to decorate a volume of fables, published at Cork.

But he was soon to enter on an ampler scene. In the twenty-second year of his age he visited Dublin on the eve of an exhibition of paintings; into which he had the satisfaction to obtain admission for his picture of St Patrick baptizing the converted King of Cashel. The admiration inspired by this piece brought Barry into notice; and his own merit concurring with a letter of introduction from Dr Sleigh of Cork, procured him Mr Edmund Burke's valuable acquaintance, which a singular circumstance is said to have quickly matured into warm friendship and steady patronage. As they disputed concerning the arts, Barry strenuously defended the principles of a late anonymous publication; this book Burke at first treated as destitute of authority, and unworthy of attention; but seeing his antagonist's zeal rising into rage, he instantly appeased his passion by avowing himself its author. Barry now, in a transport of joy, inclosed Burke in his embrace, triumphantly displaying at the same time a copy of the essay on the sublime and beautiful, which, moved by admiration, he had entirely transcribed.

After a residence of some months in Dublin he accompanied Mr Burke's family to London, was introduced by his patron to the most eminent artists of that city; and was employed in copying, in oils, the splendid views of Athens by Stuart. Under the same auspices which brought him to London, he went, in 1765, to the continent, where he spent five years, mostly at Rome, devoted to the study of the numerous and excellent models of sculpture and painting treasured up in the Vatican, and the other collections of Italy. During this period, the intemperate language with which he maintained his very peculiar opinions involved him in unpleasant quarrels, and nourished in his ill-regulated mind a gloomy suspicion that haunted and tormented him to the day of his death.

He returned to England in 1771; and as, in one of his letters, Mr Burke had suggested, "that no man can draw perfectly who cannot draw beauty," he endeavoured to gratify his patron by a delineation of Venus, in which it is said he has succeeded in exhibiting grace and beauty in their highest ideal form. He applied to the practice of the art of historical painting with persevering diligence; and the productions of his pencil were numerous, and often excellent, at least in design. His pictures of Adam and Eve, to represent the ideal perfection of the human character—of Jupiter and Juno, to exhibit the sublime—of Mercury inventing the lyre, and Narcissus admiring his own shadow, to suggest the effects of industry and idleness—and of Job reproved by his friends, to disclose patience in affliction—are specimens of his skill which must be mentioned to his praise. But his obstinacy in refusing, on frivolous pretences, to listen to the solicitations of Mr Burke, reiterated for more than two years, urging him to paint his portrait for the use of their common friend Dr Brocklesby, alienated the affections of a man who had given him numerous and substantial proofs of his friendship. This involved him in the guilt of ingratitude; and although the portrait was at last finished, confidence and intimacy were for ever at an end.

In 1777, he began his great work at the Adelphi. The Society for the Encouragement of Arts, Manufactures, and Commerce, had accepted of his offer to paint their great room, had agreed to supply him with materials, and had allowed him the choice of his subject, which was a series of poetical and historical designs. The first is the story of Orpheus; the second a Grecian Harvest Home; the third the Victors at Olympia; the fourth the Triumphs of Navigation; the fifth the Distribution of the Society's Prizes; and the last is Elysium, or Final Retribution. He commenced this magnificent undertaking with only sixteen shillings in his pocket; and, during the seven years in which he was engaged with it, he procured a scanty subsistence by sketching designs, in the evening, for the printsellers. When he had completed his purpose, the Society expressed their approbation of this grand production of genius, patience, and self-denial, by allowing its author two exhibitions, which brought him about L.300, by voting him their gold medal and L.50 in money, and by granting him an additional L.200 afterwards.

Soon after his return from Rome, Barry had been elected an associate of the Royal Academy, and in 1782 he was appointed their professor of painting, with an annual salary of L.30. The manner in which he discharged the duties of this honourable office may be learned from a perusal of the lectures which he delivered to the associates and academicians. They are six in number,—on the history,—the design,—the composition,—the light and shade,—and the colouring of painting. Of these discourses, that of colouring is allowed to be the most perfect. During the period of his professorship, violent quarrels arose between him and his constituents. Induced by these dissensions, he published his letter to the Dilettanti society, in which he displays great enthusiasm for the arts, and great contempt of the royal academicians. On this letter, and on certain parts of his lectures they founded charges against him, accusing him of encouraging a disorderly spirit among the associates and students of the academy; in consequence of which he was, in April 1799, degraded from the professorship, and expelled from the academy.

These misfortunes came upon him in a train of other calamities: Old age was approaching; he was robbed of the money which would have alleviated its infirmities; his violent and suspicious temper deprived him of the confidence and the solace of friendship. In this forlorn condition he was indeed an object of compassion, and, through the benevolent exertions of several noblemen and gentlemen, L.1000 was raised by subscription, with which an annuity was bought from Sir Robert Peele. But Barry did not live to enjoy the benefit of this charity. He died of a pleuretic fever in February 1806. His body was laid in state in the great room at the Adelphi, surrounded by his own works; and, through the generosity of Sir Robert Peele, who contributed L. 200, his funeral was splendid.

All Barry's writings,—his correspondence,—his inquiry into the causes which have obstructed the progress of the arts in England,—his lectures,—his observations on the principal paintings in Italy, &c. &c. bear the marks of a vigorous mind and an original thinker. In his whole career he acted under the influence of a powerful enthusiasm, which made him attach an importance to his art that seems altogether extravagant. Having his mind thus bent to one object, he disregarded the regulations of civilized life, and retained, amid the most polished society, the habits of a savage. His temper was violent, and his language was rude. His house presented the picture of ruin,—destitute of comfort, cold, damp, and dirty. In religion he was a Roman catholic; and although for a while his mind hovered on the verge of infidelity, a perusal of Butler's Analogy established his faith, and henceforth he held it without wavering. His stature was below the middle size,—his figure broad and strong,—his features harsh, though abundantly expressive of intelligence. There was thus in his character much to praise, and much to blame, much that excites admiration, and much that fills us with disgust.

BARTHELEMY, John James, a celebrated French author, was a native of Cassis, a small seaport town of Provence, and was born in 1716. His early education commenced in the college of the Oratory of Marseilles; but as he was destined for the church, it became necessary to prosecute the study of philosophy and theology under the Jesuits; and by his ardent zeal and indefatigable industry, his progress in the knowledge of the Greek and Oriental languages was rapid and brilliant. But intense application greatly injured his health, and he had scarcely recovered, when he was admitted into the seminary where he received the tonsure. The reading of sermons in Arabic to an assembly of Maronites, Armenians, and other catholic Arabians, and his ability in conducting a learned dialogue with a Jewish Rabbin, who had embraced Christianity, are adduced as satisfactory proofs of his skill and proficiency in oriental learning.

Attached by inclination to literature, the young Abbé, with the view of confining his pursuits to a particular department of it as a profession, repaired to Paris in 1744; he had the good fortune to be recommended to the keeper of the royal cabinet of medals; and was no less fortunate in obtaining his friendship, in being appointed his associate, and finally in 1753 his successor. With all the ardour and industry which appeared so conspicuous in his former pursuits, he entered on this new department of study; and with the same assiduity he continued his labours through life in arranging this splendid collection, and in enriching it with many fine specimens furnished by an extensive correspondence in all parts of Europe. At the urgent request of the lady of M. de Stainville, better known afterwards as the Duke of Choiseul, the Abbé visited Rome while his patron was ambassador at the court of the Vatican. This visit afforded him a fine opportunity of gratifying his ardent curiosity in the study of classical antiquity. Proceeding to Naples, he contemplated with deep interest the rich treasures collected from the ruins of Herculaneum and Pompeii, and displayed in the museum of the palace of Portici; but he beheld with regret and surprise that the manuscripts lay in the same state in which they had been discovered; and no solicitations on his part, although urged with all the warmth of enthusiasm which such objects naturally excite in a profound classical scholar, made any impression on their possessors, either in directing their own ingenuity and industry in unrolling and reading these precious relics, or in permitting the labours of others to be bestowed on them. The keepers of the musuem were strictly enjoined neither to part with any of the manuscripts, nor to allow copies of any parts of them to be taken. Disappointed in his expectation of presenting his learned countrymen with a specimen of ancient Greek writing by direct application, the Abbé had recourse to what may be regarded as a pardonable artifice in the accomplishment of his object. He was permitted to examine, for a few minutes, a manuscript of 28 lines, and from recollection he made a *fac simile* of the whole, compared it with the original, corrected the errors, and transmitted it to the academy of Belles Lettres.

The advancement of the Duke of Choiseul to the head of the public administration was an event highly auspicious to the fortunes of Barthelemy. By the favour and influence of his patron, he was placed in various official situations which afforded him a liberal income, and a large portion of leisure for literary pursuits. In 1788 his greatest work, *The Travels of Anacharsis in Greece*, appeared, and had been the subject of occasional labour for 30 years of his life. Anacharsis, the hero of this narrative, a young Scythian descended from the famous philosopher of the same name, travels in Greece about the middle of the fourth century before the Christian era, and gives an account of the arts, institutions, and manners of the Greeks. This production, the fruit of extensive erudition, profound research, and unwearied industry, gave great celebrity to the author, acquired unusual popularity, and was translated into all the languages of Europe. In the succeeding year the learned author was admitted into the French academy.

The affluence and literary repose which Barthelemy had enjoyed during great part of a long life, were disturbed in the evening of his days by the storms of the French Revolution. The suppression of pensions and offices left him little more than the scanty means of subsistence; and the suspicion of aristocracy excited against him during the reign of terror, in 1793, endangered his life. He died in 1795, when he had nearly reached the venerable age of eighty.

BARTHOLINE, Thomas, a learned physician and anatomist, was born at Copenhagen in 1616, and having finished his elementary education in his native city, acquired his anatomical and medical knowledge in France, Italy, and Germany. Returning to Copenhagen, he was first appointed mathematical professor, and afterwards advanced to the anatomical chair; and was fortunate in the discovery of the lymphatic vessels while he was employed in the dissection of a live dog, and nearly about the same time with Olaus Rudbeck. He was the author of various works connected with the studies in which he was so assiduously engaged; and he was the editor of a treatise on anatomy by his father, who had been originally a medical practitioner and an anatomist, and professor of medicine in the university of Copenhagen, but having entered into the church, he was chosen professor of divinity in the same seminary. Thomas Bartholine died in 1680.

BARTHOLOMEW, one of the twelve apostles, is supposed to be the same with Nathaniel, one of the first disciples of Jesus Christ; according to Eusebius, he preached the gospel in India, returned to the more northern and western parts of Asia, and at last came to Armenia, where he suffered martyrdom.

BARTHOLOMEW, St., one of the Caribbee islands, in the West Indies, is about 24 miles in circumference, and is surrounded by a rocky coast, which renders access to it difficult. Cotton, lignum vitæ, drugs, and provisions, are the principal vegetable productions; but the soil is chiefly fitted for pasture land. The supply of fresh water is scanty, and mostly derived from the rain collected into reservoirs. St Bartholomew was originally settled by the French from St Kitts, in which neighbourhood it lies; and, after being in different hands, was ceded to the Swedes in 1785, and taken by the British in 1801.

BARTSIA, Painted Cup, a genus of plants belonging to the Didynamia class.

BARYTES, a peculiar earth, so called from its great specific gravity, and the discovery of which is to be ascribed to modern chemistry. It constitutes the base of *heavy spar*, a mineral which abounds in metallic veins. See Chemistry and Mineralogy.

BASALT, a mineral substance, which is very abundant in some parts of the globe, and is distributed in horizontal, inclined, or vertical strata, or exhibits a regular columnar form, of which the south-west side of Arthur's Seat, near Edinburgh, some of the western islands of Scotland, and especially Staffa, the north coast of Ireland, more particularly the magnificent colonnade at the Giants Causeway, the Faroe islands, Iceland, the Lipari islands, and the shores of Sicily, furnish excellent examples. See Mineralogy.

BASE, or Basis, a term of extensive application, signifying the lowest part of a thing, as, in *Geometry*, the base of a triangle is the lowest side; in *Architecture*, the base of a column is the pedestal, or lowest part of it; and, in *Chemistry*, it denotes the alkaline, earthy, or metallic constituent of a saline body; as when soda, lime, or lead is combined with sulphuric acid, forming Glauber's salt, or sulphate of soda, plaster of Paris, or sulphate of lime, and sulphate of lead.

BASELLA, Climbing Nightshade, a genus of plants belonging to the class Pentandria.

BASHAW, or Pasha, or Pacha, is the viceroy or governor of a city, district, or province, in the Turkish dominions. Two orders of bashaws are established. The highest order is designated bashaws with three tails, because they have three tails in their military standard. The authority of this order within their government is nearly equal to that of the Grand Signior himself. The executive and military power is united in their persons, and they exercise nearly uncontrolled authority over the property and lives of all those within their proper department. The power of bashaws with two tails is more limited. Life and death are not entirely at their absolute disposal; and when they are called into the field, they are under the command of the higher order of bashaws. Bashaw, without any specific appellation, is sometimes applied to the grand vizier, and by way of courtesy to those who hold conspicuous stations at the Ottoman court.

BASHEE, or Bashi islands, a group of islands between Formosa and the Philippine isles, in the Chinese sea, present a varied surface of rugged mountains and fertile vallies, and produce the fruits of tropical regions, with sugar canes and cotton.

BASHKIRS, a tribe of people subject to Russia, and inhabiting the banks of the Ural and Volga, are descended from the Nogay Tartars, resemble them in manners, and lead a pastoral life. They rear cattle, horses, and camels, cultivate a little barley and oats, and are successful in the management of bees. The Bashkir troops, of which they are required to furnish 3000 cavalry to the Russian army, are expert horsemen, and dexterous marksmen with the bow and arrow.

BASIL, Saint, who obtained the surname of the Great, was one of the most learned bishops of the early Christian church, was a native of Cæsarea in Cappadocia, studied at Constantinople and Athens, and having travelled in Syria, Egypt, and Lybia, devoted himself to a monastic life. He was admitted into the order of priesthood by the learned Eusebius, bishop of Cæsarea, and on the death of that patriarch he was recalled from religious retirement to be his successor. The controversy which then prevailed concerning Arianism, which he refused to embrace at the entreaty of the emperor Valens, had nearly involved him in persecution; and all his influence was fruitlessly exerted in composing the dissensions which distracted the eastern and western churches. He died in 379, and in the fifty-third year of his age. St Basil is regarded as one of the brightest ornaments of the early church. His powerful genius, his skill in controversy, and an exuberant flow of eloquence, placed him in the first rank in the age in which he lived. The Paris edition of his works, Greek and Latin, and in three vols. folio, is considered the best.

BASILISK, an imaginary animal of the reptile kind, to which very extraordinary powers were assigned in the descriptions of the older naturalists, among which, it was said, that its breath was so pestilential that no other animal could live near it, and even its look was fatal to those on whom it cast its eyes. But these idle stories, improbable in themselves, and fitted only to excite wonder, or to amuse credulity, are disproved by accurate observation, and sink into obscurity before the light of true knowledge.

BASINGSTOKE, a town of Hampshire in England, occupies a fine situation in a fertile open country, contains a population of 2589, and has some woollen manufactures, particularly shalloons and druggets. Its market for corn and malt is considerable, and is greatly facilitated by inland navigation. It is 46 miles west from London.

BASLE, Basil, or Bâle, a canton of Switzerland, stretching along the banks of the Rhine, about 20 miles in length, and at its greatest breadth about 16 miles, including an area of 160 square miles, and a population stated at 40,000, enjoys a fine climate, and from the diversified aspect of lofty mountains and fertile well cultivated vallies, presents some beautiful and picturesque scenery. The vallies afford abundant crops of grain, the hills are clothed with rich vineyards, the more elevated regions are adorned with waving forests, and the chain of Jura, rearing its lofty summits in the clouds, seems to form an insuperable barrier to the whole district. The woods abound with game, and the waters of the Rhine, as it rolls its noble current through the canton, are well stored with excellent fish.

The labours of agriculture are prosperous and productive. Silk stuffs, printed cottons, gloves, paper-making, bleaching, and dyeing, are the chief manufactures.

The administration of the affairs of the canton is entrusted to the *great* and *little* council. The great council is composed of 216 members; the little council consists of 60 members; and the four chiefs of the canton being added, make up the supreme council of 280 persons, in whom are vested the chief direction of affairs, legislative authority, and the disposal of the principal offices. But with all the boasted freedom and happiness which the civil polity of this canton was supposed to bestow, and with all the benefits attending popular elections, undue influence and intrigue crept in, and prevailed to such a degree as to induce the citizens of Basle to have recourse to the singular mode of choosing their magistrates, filling up vacancies in offices, and even supplying the vacant chairs in the university by lot. Basle was the first canton which separated from the ancient confederacy, and joined the French in their revolutionary career, and, according to the constitution established in 1801, formed a department.

BASLE, or Basil, the capital of the canton of the same name, occupies a fine situation on the banks of the Rhine, which, with its broad, deep, and rapid stream, separates the city into the large and small town, united by a magnificent bridge of 14 arches, and 600 feet in length, and is surrounded with walls and a ditch. The houses are remarkable for neatness and elegance; the streets and squares are spacious; and the public fountains, which are numerous, and copiously supplied with water from the neighbouring streams, are equally ornamental and salubrious. The cathedral, a grand Gothic edifice, which includes within its walls the tomb of Erasmus, the brilliant ornament of literature in the fifteenth century, cannot fail to be venerated by the classical scholar. The hanger, seal, some manuscript letters, and the last will of the same learned man, are still preserved with pious care in the public library, which is also enriched with other valuable manuscripts, and particularly with the letters of the early reformers; and in apartments connected with the same institution are deposited many original paintings of the celebrated Holbein, a native of the place. The university founded in 1460 has enjoyed great reputation, and has been adorned by some of the most illustrious names in science and literature.

Basle was at one time regarded as the most populous town in Switzerland. The population, it is stated, has been reduced to 14,000, owing, it is alledged, to emigration, a practice common throughout the Swiss cantons. The manufactures enumerated in the account of the canton, are chiefly confined to the towns. The invention of the manufacture of paper in 1417, and the discovery of the art of printing in the succeeding year, are claimed by the inhabitants. Basle is 120 miles north-east from Geneva, and 60 miles south from Strasburg.

BASLE, or Basil, a bishopric and province in the circle of the Upper Rhine in Germany, lies partly in Germany and partly in Switzerland, and is remarkable for its picturesque scenery. The bishop was a prince of the German empire before the annexation of the province to the French territory during the revolution, and has now probably been reinstated in his authority. The population is stated at 50,000, of whom 15,000 are protestants, who chiefly reside in the valley of Munster.

BASS, an island in the mouth of the frith of Forth in Scotland, is about three miles distant from the southern shore, scarcely exceeds half a mile in circumference, and, excepting on the south-west side, where landing is not without difficulty, rises precipitously from the ocean not less than 400 feet above its surface. The rocks are chiefly of a basaltic nature; they are adorned with the sea tree mallow, *lavatera arborea*, one of the most splendid native plants, which grows to the height of six feet; some scanty herbage affords pasture to a few sheep; and the Bass has been long famous as the summer resort of the solan goose, one thousand of the young of which are annually caught for the Edinburgh market. These birds usually appear about March and April, and migrate in September.

The Bass, which is now part of the North-Berwick estate, was once public property; and during the distracted reigns of Charles II. and his successor, served the purpose of a state-prison. At the revolution it was held by some of the adherents of James, and is said to have been the last place which yielded to the new government. The fortifications were then dismantled.

BASS-STRAITS, the channel which separates New Holland from Van Diemen's land, derives its name from Mr Bass, a surgeon of the British navy, the enterprising discoverer, who explored it in an open boat through its whole extent. The voyages of future navigators have confirmed his discovery, and have contributed additional information to render its geographical details more complete and satisfactory. The channel is reckoned to be about 50 leagues from east to west, and the breadth in many places from north to south is not less. The passage through this channel, although somewhat dangerous from numerous rocks and islands, abridges the voyage from Europe to India, and the seal-fishery on the shores and islands promises to become a lucrative branch of commerce; but the number of adventurers, among whom the Americans were active and industrious, soon greatly exceeded the prolific supply of the animals, the fishery declined, and the British settlement at Fort Philip, on the northern shore, has been abandoned. Collins's *Account of Botany Bay*.

BASSANO, a town on the river Brenta, in the Trevisano in Italy, contains a population exceeding 11,000, with 30 churches and two monasteries. The manufactories of silk and woollen are considerable, and the business of printing is extensively conducted. A severe action between the French and Austrians was fought near Bassano, in the early period of the French revolution. Bassano is 12 miles north from Vicenza.

BASSET, a game which is played with cards, and is of so hazardous a nature, that it is said the inventor, a noble Venetian, was banished; and very severe edicts were made against it by Louis XIV. after its introduction into France.

BASSET, or BASSETING, terms employed in coal-mining operations in some districts, and are analogous to the *crop* and *cropping* out of the coal stratum, or that part of the inclined stratum which comes nearest to the surface of the earth.

BASSO RELIEVO, or LOW RELIEF, is that kind of sculpture in which figures are so represented that no part is detached from the back ground, and is distinguished from *alto relievo*, *high* or *bold relief*, in which parts of the figures rise above the surface.

BASSORA, or BUSSORA, a commercial city of Arabia Irak, occupies a central position between the junction of the Tigris and Euphrates and the Persian gulf, dates its origin from the caliph Omar, about the 16th year of the Hegira, who planned and built it for the purpose of facilitating the trade between the eastern empire and India, and continued under the Saracens till the Turks became its masters, about the middle of the 17th century. It afterwards fell into the hands of the Persians, but after a short possession was evacuated, and has since been subject to the dominion of the Ottoman Porte. In modern times, Bassorah has sustained numerous unsuccessful attacks from the new sect of the Wachabees.

The population of Bassorah, composed of Christians, Jews, Persians, Indians, and Arabians, is stated at 40,000, probably from its languishing commerce, a much smaller number than it could boast of in the days of its prosperity. But it is still a considerable emporium for exchanging the merchandize and manufactures of the west for the rich productions of eastern regions. The annual amount of the trade of Bassorah, was some years ago, according to Abbé Raynal, equal to L.525,000 Sterling. It is now chiefly in the hands of the English and Arabians.

BASTIA, a sea-port town, and capital of the island of Corsica in the Mediterranean, contains 6000 inhabitants, and has been often the object of attack and defence during the political struggles which have disturbed the repose of Europe. It fell into the hands of the British in 1794, but has been, since the general pacification, restored with the island to its former masters. The harbour is sufficiently commodious for small vessels, but the trade is not considerable.

BASTILE, the well known and once dreaded state prison of France, stood near the gate of Paris, on the road which leads to St Anthony, and was erected in 1370, in the reign of Charles V. by D'Aubriot, mayor of Paris, who it is said became its first inhabitant. The word signifies a *building*, and similar structures, destined to similar purposes, were established in different parts of the French dominions. The original building consisted only of two towers, on opposite sides of the street, and connected by a wall, in the centre of which was the opening for the city gate. This gate was closed up when a new approach to that quarter of the city was made; other towers were raised, and with connecting walls formed two complete courts; and the whole was surrounded by a ditch secured by a counterscarp. The walls of these courts were of immense thickness, and the height from the pavement in the inside was not less than 80 feet. Succeeding monarchs extended and strengthened the various parts of this immense fabric, as jealousy or despotism required. The towers, the usual places of confinement for those who were unfortunately immured in the Bastile, consisted of a sunk story, or dungeon, and four upper stories. The dungeon was paved and arched with stone; a little light was sometimes admitted, and sometimes it was entirely excluded; but no stove or fire-place was ever allowed. The dungeons of the towers, it is said, were assigned to those who had attempted to escape. The four stories of the towers formed each a single apartment of 18 feet diameter, and of the same height. The walls of the upper stories were 12 feet thick, and those of the lower apartments were still thicker. A single window admitted light to each apartment; the windows and chimney were secured by strong double gratings of iron, and the double doors were of oak-plank, and each three inches thick. A bed, a table, a chair, and a few necessary utensils, constituted the whole furniture. The whole internal management of the Bastile was entrusted to a governor and his inferior officers. Physicians, chaplains, and a company of invalids composing the garrison, were also attached to the establishment.

Those who became the objects of royal or ministerial resentment, were committed to the Bastile by secret orders, called *lettres de cachet*, in which no specific charge was brought against them, no period fixed for bringing them to trial; and thus all hope of regaining their liberty vanished. They were precluded from all connexion with their friends or the world. Insidious questions were proposed to them during their examination, and the hesitating answers were recollected and recorded, and thus they were often brought to involve themselves in imaginary guilt. It is said that torture was at one time employed to extort information, and that poison had been secretly administered to remove those whose presence had become too obnoxious even within the walls of these dreary mansions. But the uncertain state of mind, under which some of the inhabitants of the Bastile passed the tedious days of their imprisonment, was the bitterest cup of their misery. Often altogether ignorant of the cause of their confinement they saw no prospect of its termination. The history of the Bastile, accordingly, furnishes some examples of periods of imprisonment which seem almost incredible. When Louis XVI. ascended the throne, he ordered the registers of the Bastile to be examined, and some of the prisoners to be released from confinement. Among the number was an old man, who had been secluded from the world for the long space of 47 years. When his liberty was announced to him, he seemed scarcely to understand its meaning, and received the news with none of those feelings of lively joy which the prospect of so great a boon usually inspires. Leaving his dungeon, and being conducted to the street where he had once lived, he could not discover the least trace of his former abode; a public building was erected on the spot where it had stood. His family and relatives were all dead or dispersed. None of those, even the most advanced in life, whom he addressed, remembered him, or recollected any of the events to which he alluded. A whole generation had passed away; a new race had sprung up; and in his native city he was an utter stranger. From an old domestic, whom he accidentally discovered, he learned that his wife, worn out with anxious expectation and unavailing sorrow, had sunk to the grave 30 years before; and that his children had gone abroad to distant climes. At this tale of woe, the aged man, seeing himself left alone in the world, groaned deeply, and, it is said, actually applied to the minister to be restored to his prison, adding, " Is it possible in the same moment to hear of this universal destruction and not wish for death? How can I survive the loss of relations, of friends, of a whole generation. There seems nothing terrible in dying; but it is indeed a dreadful thing to be the last." The minister had compassion on the unfortunate old man, caused the ancient domestic to attend him, for he only could converse about his family; and this was the single consolation which he enjoyed in the new scene of his existence, which the chagrin and mortification of being the last of his race soon closed.

The Bastile became an object of the fury of the populace at an early period of the French revolution. On the 14th of July 1789, it was attacked and taken by the Parisian mob, and afterwards razed to the ground. Seven prisoners only were discovered within its walls, and none of them appeared to have been the victims of tyranny or wanton oppression. Six of that number were Frenchmen, one of whom was deranged; four were imprisoned for forgery; and the fifth, who was of the rank of nobility, had been arrested and confined at his father's request. The seventh prisoner was an Englishman, also in a state of mental derangement.

BASTINADO, or BASTINADE, a mode of punishing offenders which was practised among the nations of antiquity, and is common in eastern countries at this day. The name is derived from the French *baston*, signifying a *stick* or *staff*, the instrument of punishment. *Fustigation*, or beating with sticks, was well known to the Romans; and the bastinado of modern times is a summary mode of punishment among the Turks and Chinese. The offender is laid prostrate on the ground, his legs are raised and secured by the ancles in a wooden apparatus, and two men, each with a rod about the thickness of a small walking staff, beat alternately on the soles of his feet till the number of strokes, from a few dozens to 300 or 400, according to the sentence, be completed. A fine, the amount of which is regulated by the number of strokes inflicted, also accompanies this punishment among the Turks.

It is not a little singular that this mode of punishment should not be regarded with ignominy among their Chinese,—a remarkable feature in the character, when contrasted with the manners and feelings of Europeans. The emperor himself orders this chastisement to be inflicted on his courtiers, who are not disgraced, but consider it as a mark of paternal care, receive it with gratitude, are again admitted into favour, and treated with peculiar respect. Every mandarin has the power of ordering a similar punishment to be inflicted on petty offenders. In the hall of judgment a bag filled with small sticks is placed on a table before him. The signal of punishment is to take one of the sticks from the bag, and to throw it on the floor towards the offender, who is immediately seized by the attendant officers, thrown prostrate on the ground, and receives five smart blows from one of the officers, and the same number from another; and if the mandarin take another stick from the bag, the same process is repeated, if not, the punishment is completed, when the culprit falls on his knees before his judge, and with three inclinations of the body, thanks him for the paternal concern which he has thus expressed for his morals.

BASTION, a term in fortification, signifying a mass of earth faced with sods, brick, or stone, and projecting from a rampart. Bastions are said to be *solid* when the interior is entirely filled up,—*void*, or *hollow*, when the inside is empty. A *flat* bastion is built in the middle of the curtain, when it is too long to be defended by the bastion at its extreme parts. A *cut* bastion has the point cut off, and instead of it a re-entering angle, with two points outwards. A *demi* bastion is composed of one face, and has but one flank. A double bastion is raised on the plane of another bastion.

BAT, a genus of animals belonging to the class Mammalia. See *Vespertilio*, under MAMMALIA.

BATALHA, a small village about 60 miles north from Lisbon in Portugal, which is remarkable for one of the most magnificent specimens of Gothic architecture in Europe. This splendid structure is indebted for its origin to Don John, the first of the name as king of Portugal, who being invaded by the king of Castile with a powerful army, invoked the protection of the Virgin, and having defeated his enemy, raised this noble structure as a lasting memorial of his gratitude. The monastery of Batalha was founded in 1385, and the architect who designed and constructed this grand edifice was, it is said, a native of Ireland. The whole building, but especially the mausoleum of the founder himself, is richly decorated with an immense profusion of all kinds of ornaments, some of which are of a hieroglyphical description, and are scarcely intelligible. The monastery of Batalha is the burying-place of the royal family of Portugal. The earthquake of the first of November 1755, which laid Lisbon in ruins, and was felt throughout Europe, did considerable injury to the buildings; and the spire of the mausoleum was thrown down. The curiosity of those who wish to be acquainted with this magnificent Gothic structure, will be amply rewarded by consulting the splendid work of Mr Murphy, exhibiting *plans, elevations, sections and views of the Church of Batalha.*

BATAVIA, one of the principal towns of the island of Java, and formerly the capital of the Dutch settlements in the East Indies. See JAVA.

BATCHISARAI, or BAKTCHISARAI, a town of the Crimea, which is famous as the ancient residence of the Tartar khans, or governors of the country, and occupies the sides of two mountains and the intermediate valley which is traversed by a river. The streets are long and narrow, and are filled with shops. But the towers of numerous mosques, the tall poplars, the terraces, fountains, and hanging-gardens, render the whole scene extremely picturesque, when it is seen from a distance. The population, composed of Tartars, Jews, Greeks, and Armenians, is nearly 6000; and cutlery, morocco leather, woollen stuffs, and rope-making, are the chief manufactures.

BATH, a city of Somersetshire in England, is finely situated on the side of a narrow valley on the banks of the Avon, is well sheltered by a range of hills on all sides, excepting to the north-west, where the vale expands into rich meadows, and derives its modern, as well as its ancient names, from the quality or uses of its copious mineral springs. The "hot waters" of Ptolemy; the AQUÆ SOLIS, "waters of the sun," of the Romans; "the city of baths" of the Britons, and the "city of valetudinarians" of the Saxons, have each its obvious allusion.

Ancient city.—The local position of Bath, and the enjoyment of warm-bathing, so congenial to the habits of the luxurious Romans, rendered it a favourite residence, and one of their chief towns during their stay in Britain. Two spacious streets, crossing each other at right angles, and terminating in four gates, which looked to the four cardinal points, divided the town into four parts, and gave it a regular form. The general outline was somewhat of a five-sided figure, the sides of which were nearly equal; and a wall composed of stone and brick, 20 feet in height, and flanked with round towers at each angle, included an area of 1000 square yards. The temples, baths, and other public edifices which they erected, were of the most magnificent description. In 1755, the remains of an elegant structure, destined to the purpose of a sudatory, was discovered 20 feet below the surface, in digging the foundation of a modern building. The floor of the ancient fabric, which was still entire, was supported by pillars, and surrounded by tubulated bricks, to permit the passage of the heat and vapour. This bath was supplied from a hot spring; and the sewer for the conveyance of the waste water was still in a perfect state. But the repossession of Bath by the Britons after the departure of the Romans, or the succeeding invasion of the kingdom by the Saxons, was fatal to the splendour of this fine city. A period of 200 years had scarcely elapsed, when the Roman city had totally changed its aspect; and Roman magnificence could only be traced in the fragments of columns, sculptures, and other architectural decorations inserted into the walls which the invaders had erected for their own defence. Amidst the revolutions of the kingdom, and the various changes of its own fortunes, Bath seems to have been always a place of importance and consideration. The population was respectable at the time of the Norman conquest; in the time of Henry VIII. the manufacture of woollen stuffs was prosperous; and for the improvement of its municipal institutions, Queen Elizabeth renewed and enlarged its charters and privileges.

Modern city.—Bath, in its present state, is pronounced the pride of England and the admiration of foreigners; and its elegant streets, spacious squares, and magnificent buildings, seem to entitle it to this distinguished appellation. The Royal Crescent, a noble assemblage of thirty houses, distributed in an elliptical form, and adorned with Ionic columns, supporting the superior cornice, commands a picturesque view of great part of the city; the Circus, in which the buildings, decorated with three ranges of pillars of the Doric, Ionic, and Corinthian orders, are disposed circularly, and constructed according to the same uniform design, has, in the centre, a fine reservoir of water, collected from springs in the higher grounds, and destined to supply the neighbouring streets; and the Old Assembly Rooms, 90 feet in length, 36 feet in breadth, and 34 feet in height, afford a charming prospect of the river and the surrounding hills; but the New Assembly Rooms, completed in 1771, are still more spacious and elegant; of which the ball-room is 106 feet long, 42 feet wide, and the same dimensions in height; and of two card-rooms, one is of an octagonal form, and 48 feet in diameter, and the other, of a rectangular form, is 70 feet long and 27 feet broad. The public hospitals, for the relief of the sick and poor, are numerous and well-regulated, and some of the edifices are elegant structures. The Abbey-church, with its noble tower, rich west window, and arched door-way, and the splendid monuments with which the inside is decorated, is an admired specimen of architecture.

Waters, baths.—The Bath water is impregnated with a small portion of iron, a little calcareous and siliceous earth, and a small proportion of azotic and carbonic acid gases. Beside a number of private baths, four on a large scale, destined to the use of the public, have been constructed. The King's bath, 68 feet long and 40 broad, is supplied from a spring in the centre, which is inclosed by a brass rail, and is surrounded by an elegant Doric colonnade; the Queen's bath, supplied from the former, is a bason 25 feet square; the Cross-bath, at the end of Bath street, is of a triangular form; and the hot-bath, in which the water rises to the temperature of 117° Fahrenheit, is erected at the distance of 120 feet from the King's bath.

Population, &c.—The number of inhabitants estimated at 27,686 in the year 1801, had increased in 1811 to 31,496. Bath may be regarded as a place in which, from the great resort of fashionable company, the wealth and taste of the kingdom are displayed, rather than the seat of trade and manufactures. The amusements are regulated and conducted according to the most polished forms of etiquette; the rides and walks in the vicinity are delightful; and accommodations of all kinds for those who seek health or pursue pleasure, are abundantly provided.

Bath has been long distinguished by a respectable institution, the Bath and West of England Society for the Encouragement of Agriculture, Manufactures, &c. and the intelligence and activity of its members are sufficiently conspicuous in the volumes of its Transactions before the public. The Philosophical Society, for the purpose of promoting literature and science, was instituted in 1799. Bath and Wells form one bishopric, and the diocese includes the whole of Somersetshire, excepting a few churches in the city of Bristol. Warner's *history of Bath*.

BATH, Knights of, a military order in England, which is supposed to derive its name from the ancient practice of bathing, which was one of the solemn *rites* observed previously to installation, and an emblematical expression of the obligation to preserve integrity and purity of mind. It is supposed that this order was introduced into England by the Saxons; William the Conqueror conferred it both on his Norman and English subjects; but it seems not to have been fully instituted till the time of Henry IV. who, on the day of his coronation, nominated forty-six companions. It continued afterwards, at the celebration of the royal nuptials, or other solemn occasions, to be the practice of his successors to create Knights of the Bath; and at the coronation of Charles II. a splendid installation of sixty-eight knights took place. It fell into disuse till the year 1725, when it was revived by George I. erected into a military order, to be composed of a grand master and thirty-six knights-companions, and regulated by a system of statutes drawn up for its government. See Heraldry.

BATHING is the immersion of part or the whole of the body in water or some other fluid. Cold and hot water, salt and fresh water, mineral waters, and steam or vapour, are employed with different intentions for the purpose of bathing. See Materia Medica.

BATNIR, the capital of a district in the north-east quarter of Hindostan, some parts of the district of which are near the banks of the rivers, and have the advantage of annual inundations, are distinguished by the fertility of the soil, and produce abundant crops of rice, wheat, and barley; but the more elevated regions, which are subject to severe droughts, are no less remarkable for their sterility.

The inhabitants of this country, who profess Mahometanism, are described as a cruel and ferocious people, addicted to plunder from their earliest years, and even, it is said, wantonly putting to death the unfortunate victims who fall into their hands.

BATRACHOMYOMACHIA, from the Greek, signifying the Battle of the Frogs and Mice, is the title of a burlesque Greek poem, which has been generally ascribed to Homer. The subject of the work is the death of a mouse, who being mounted on the back of a frog, on a voyage to her palace, to which he had been invited, was seized with fear in the middle of the water, fell off, and was drowned. The mice, suspecting that their friend had not been fairly treated, demanded satisfaction, and declared war against the frogs.

BATTALION, a body of infantry composed of an indeterminate number of men, varying from 500 to 1000. In the British army, some regiments consist of a single battalion, but others have two or more.

BATTEL, or Battle, a town of Sussex in England, which is famous in history on account of the abbey called Battel abbey, which was erected by William the Conqueror to commemorate his victory over Harold king of England on the 14th October 1066. The magnificent remains of this edifice, which are yet visible, afford ample proof of its ancient splendour. Battle has been long celebrated for the manufacture of gunpowder of an excellent quality; the number of inhabitants in 1801 exceeded 2000, and the distance from Hastings is six miles, and from London 57 miles.

BATTEL, or Battle, or *Trial by Wager of Battle*, is a mode of deciding differences which was resorted to in the less civilized periods of society in Europe, and no doubt derived its origin from the military spirit of the times, and the pious but superstitious confidence in the interposition of heaven in favour of the injured party. The regular forms of judiciary combats are supposed to have been first introduced among the Burgundi, a tribe of Germans who settled in Gaul. But a wider range of observation may trace the spirit of the practice, if not the formal solemnities, to every ancient warlike nation. Under the immediate influence of their tutelary divinities, the heroes of Homer often engaged their enemies in single combat; aided by the God of battles, David, on the part of Israel, slew Goliah, the champion of the Philistines; and of a similar character, although three warriors fought on each side, was the desperate conflict between the Horatii and Curiatii, which holds so conspicuous a place in Roman history.

But the judiciary combat assumed its most prominent feature in the feudal ages, and became a part of the civil polity of those countries where feudal institutions were established. This mode of trial was introduced into England by William the Conqueror, and it was employed in military, criminal, and civil cases; the first in the court martial, or the court of chivalry and honour, the second in appeals of felony, and the third upon issue joined in a writ of right, the last and most solemn decision of real property. The last trial of this kind, waged in the Court of Common Pleas at Westminster, was in 1571, in the time of Queen Elizabeth, and was held in Tothil-fields. In 1631, a trial by battle took place in the court of chivalry; and a similar case occurred in 1638, in the county palatine of Durham. Of the equity of such decisions, no remark is necessary to rational readers; and yet the duel of modern times, which is still resorted to as the test of honour, and practised in open violation of the laws of God and man, may justly be regarded as a barbarous remnant of the false notions in which the whole system originated.

BATTERING, in modern warfare, is the attack of a strong place with heavy artillery.

BATTERING-RAM, an ancient military engine, which was employed in beating down the walls of besieged places, which is said to have been invented in the fifth century before the Christian era. This machine was composed of a beam, sometimes 80 and 100 feet in length, headed with iron resembling a ram's head, from whence the name, and suspended by ropes from a strong frame, which moved on wheels. The iron head of the beam was propelled against the wall intended to be battered, by the labour of men; and sometimes not fewer than a hundred were employed in the operation.

BATTERY. See *Fortification* under WAR.

BATTERY, Electrical and Galvanic. See ELECTRICITY.

BATTLE, an engagement between two hostile armies. See WAR.

BAVARIA, a circle or kingdom of Germany, situated between 47° and 48° of north latitude, and 10° and 13° of longitude east from Greenwich; is bounded by Franconia and Bohemia on the north, by Austria and Styria on the east, by Carinthia and Tyrol on the south, and by Swabia on the west, and contains the archbishopric of Salzburg, indenting itself between Austria and the Tyrol, the duchy of Bavaria occupying the south-western division, and the palatinate reaching from the Danube to the confines of Franconia and Bohemia. This region from south to north extends 200 British miles in length; and from east to west it is about 130 in breadth.

Physical state.—The external appearance of Bavaria is greatly diversified by high mountains and deep vallies; by numerous lakes, and copious streams; by large cities, and smaller towns; by stately mansions, and scattered hamlets. Many of its mountains, especially toward Tyrol, rise to the clouds in bold, precipitous, rocky masses; many of them are thickly clothed with deep, and even impenetrable forests; and many of them are verdant with rich and luxuriant pastures. They are composed of granite, gneis, micaceous, and argillaceous schistus; and in many places abound with metallic ores. A multitude of lakes, to the number of 176, as travellers report, of various sizes, and at frequent intervals, is scattered over the whole of the southern side of the country; and these lakes, which derive their waters from the melted snow of the mountains, feed the rivers which traverse, beautify, and enrich the region. Of these rivers the majestic Danube, in its course from Swabia towards Austria, divides Bavaria into two great departments, and is augmented by numerous tributary streams. Except the Altmuhl and the Nab, the rivers of the division north of the Danube are not considerable; but that of the south, which is the region of the lakes, is intersected in every direction by many large streams. On the east, the Inn, which rises in Switzerland, and flows towards the Danube, through the archbishopric of Salzburg, forms the line of separation between Austria and Bavaria; and the Lech, which has its source in Tyrol, divides it from Swabia; and the Iser, as it winds its way in the same direction through the heart of the country, receives many tributary streams.

Productions.—Bavaria is rich in minerals; in her rocks are mines of gold, silver, copper, iron, and lead; also quarries of marble, with an endless store of architectural materials. Pearls have been found in some of her rivers; and her alum and salt excite the industry of the people, and afford a revenue to the state. Her mountainous soil, indeed, is less adapted for the culture of corn than for the rearing of cattle; but on the banks of the rivers. and in the retired vallies, are many fertile tracts; and most of that part of the country which stretches from Munich to the Danube, is well fitted for all the purposes of agriculture. But this art, which tends so much to promote the beauty of a country, and to secure the independence, and mark the improvement of a people, has hitherto, in Bavaria, continued in the most wretched condition. Under a proper system of management she might easily support a far denser population, well supplied with the richest gifts of the teeming earth; her warm vallies would nourish the vine, and bring to maturity some of the choicest fruits,—would crown her year with abundance, fill her barns with plenty, and the houses and the hearts of her inhabitants with gladness. And yet, through neglect, induced by ignorance and impolicy, this country, so highly favoured by nature, continues almost destitute, not only of orchards and vineyards, but even of the common culinary vegetables, and knows no other system of culture but that which has descended from remote and barbarous antiquity.

Social and political state.—The population of Bavaria has lately been ascertained with all the inquisitorial scrutiny which marked the reign of Napoleon Bonaparte. By his ordonnance, issued in the year 1808, it was divided into the following 15 circles: Mein, Pegniz, Nab, Retzal, Altmuhl, Upper Danube, Lech, Regen, Lower Danube, Iser, Salzbach, Iller, Inn, Eisak, and Adige, extending over a surface of 1636 square miles, and containing 3,231,538 inhabitants.

Cities.—Bavaria is thickly studded with cities, towns, and villages, of which the principal are Munich, the capital of the country, built on the Iser, adorned with an elegant palace, and many other public buildings, and enriched also by an academy of sciences founded in 1759, and inhabited by more than 50,000 human beings: Ingolstadt, 45 miles north of Munich, the seat of a university; this town contains 7000 inhabitants, is regularly built on the Danube, it is fortified by a wall and environed by a marsh, so that it is one of the strongest towns in Germany: Friedberg, a little town, but famous for clocks and watches: Salzburg, the capital of the archbishopric of that name, situated amid wooded rocks and cultivated hills, having a university, a cathedral, a palace, and 15,000 inhabitants: Amberg, the capital of the palatinate, a fortified town, with a palace, a cathedral, &c. and about 5000 inhabitants: Passau, built on a hill at the conflux of the Inn and the Danube, a trading town, with 9000 inhabitants, famous for the treaty between Charles V. and the Elector of Saxony, concluded in 1552; and Ratisbon, an imperial city, at the conflux of the Regen and the Danube, fortified in the form of a crescent, and containing nearly 30,000 inhabitants.

Manufactures, &c.—Those arts which minister to the luxury of the opulent, are more practised in Bavaria than such as tend to excite the industry and enterprise of the people; to open the sources of individual emolument and of national wealth, and to promote the solid enjoyment and the respectability of life. She has in her capital more goldsmiths and engravers, hairdressers and gingerbread-bakers, than manufacturers of leather, or woollen, or cotton-cloth. Tobacco and salt are the staple commodities which are prepared for the market, as well as produced in the country. But she exports great quantities of timber, iron, rough hides, raw wool, &c.

Government.—The assembly of the states of Bavaria is made up of three orders,—the prelates, the nobility, and the people. The half of the votes belong to the nobility, and the other half is divided equally between the other two orders. The duchy is divided into four governments,—Munich, Straubing, Landshut, and Burghausen, each of which is represented by two peers, a prelate, and a deputy for the towns, in the assembly of the states. The hereditary offices of the elector, now the king, are the governor of the royal domains, the steward, marshal, cup-bearer, and huntsman. In respect of rights and dignities, the king, except the circumstance of his new title, is nearly on the same footing with the electors before him. He is arch-seneschal of the empire.

Revenue.—A tax is levied on all the land of the electorate without exception. The 25th part of the produce constitutes the tax, for which the farmer has a draw-back for feu-duty and the expense of culture. This impost on the land is denominated the general revenue of the country. The electoral revenues arise from fines, quit-rents, escheats, and other baronial rights, from duties on breweries, on the commodities consumed in the towns, on salt-works, coinage, the produce of the forests, and on imports; the annual amount of the whole of these imposts is estimated at 12,000,000 of florins. Bavaria maintains a military force of about 12,000 men. They are said to be impatient of discipline and order, much disposed to ravage a hostile country, but withal exhibiting occasionally surprising feats of bravery.

Religious and moral state.—The Roman catholic religion is established in this part of Germany. The archiepiscopal see of Salzburg was founded by Rupert, an Englishman, in 716. The archbishop is primate of all Germany, and as, of the 24 persons of high rank which compose his chapter, 20 are Austrians, the whole court, in political matters, is under the influence of Austria. The whole country abounds with religious houses, churches, chapels, and convents; and swarms with ecclesiastical persons of different orders, full of mutual hatred towards each other, but maintaining an unlimited influence over the people of every rank. Half of the inhabitants were once protestants, but, owing to the persecutions by which they were harassed, most of them have abandoned their native soil for the woods of America. Indulgences are sold at a moderate price for the most enormous crimes. After this it will be unnecessary to add, that superstition and bigotry are the prominent qualities of a Bavarian's religious character. It is easy to infer the moral influence of such a corrupted creed; and in this the most uncharitable reasoner will not exceed the truth. The representations which travellers have given us of the disgusting grossness of the Bavarian manners, seems indeed almost incredible. The peasants are coarse, slovenly, and ferocious, living in hovels full of smoke, filth, and vermin. The court of Munich maintains no less than four thousand men, who, from ignorance, have no relish for rational employment, but spend their whole time in gaming and debauchery. Their example is imitated, and the contagion spreads throughout the country, till, according to the remark of a Gascon officer, Bavaria has become the largest brothel in the world.

Characteristic incident.—A scene, of which Baron Reisbach was an eye witness, will illustrate Bavarian superstitiou and brutality. "I happened, says the Baron, to stroll into a dark black country beer-house, filled with clouds of tobacco, and on entering I was almost stunned with the noise of the drinkers. By degrees, however, my eyes penetrated through the thick vapours, when I discovered the priest of the place among fifteen or twenty drunken fellows. His black coat was as bad as the frocks of his flock, and, like the rest of them, he had cards in his left hand, which he struck so forcibly on the dirty table, that the whole chamber trembled. At first I was shocked at the violent abuse they gave each other, and thought they had been quarrelling, but soon found that the appellations which shocked me were only modes of friendly salutation among them. Every one had drunk his six or eight pots of beer, and they desired the landlord to give them a dram of brandy, by way they said of locking the stomach. But now their good humour departed, and preparations were made for a fray, which at length broke out. At first the priest took pains to suppress it; he swore, he roared as much as the rest. Now one seized a pot and threw it at his adversary's head; another clenched his fist; a third pulled the legs from a stool to knock his enemy on the head; every thing seemed to threaten blood and death, when, on the ringing of a bell for evening prayer, *Ave Maria ye!* cries the priest, and down dropped their arms, they pulled off their bonnets, folded their hands, and repeated their Ave Marias. As soon, however, as their prayers were over, their former fury returned with renewed violence; pots and glasses began to fly. I observed the priest creep under the table for security, and I withdrew into the landlord's bed-chamber."

After this, we are not surprised to learn from the same author, that in external appearance a Bavarian is a most grotesque figure, rather a caricature than a man. His head is round, and his chin peaked; his belly is prominent, and his legs short and unshapely, his eyes sunk, and his complexion pale; the whole exhibiting the most ungainly awkwardness, and betraying inbred depravity. But how is this description to be reconciled with that of the women, with which it is completely contrasted? They are represented as being exquisitely beautiful. Their form is perfect symmetry,—the pure whiteness of the lily, softly tinged with warm purple, as if by the hands of the graces, gives a clear transparency to their complexions; their manners are lively, graceful, and elegant; in short, from head to foot, in body and mind, they are said to be altogether lovely.

History.—Bavaria derives its name from the Boii, an ancient Celtic tribe of Gaul. During the decline of the Roman empire, and the kingdoms which rose on its ruins, she was subject to many masters, and was severed and separated into many fractional parts, according as the sons and servants of her conquerors were in want of inheritances. In the ninth century the Francic family assumed the title of kings of Bavaria. In the thirteenth century the house of Bavaria acquired the palatinate by marriage. Frederick V. elector palatine, married the daughter of James I. of England, and aspired unsuccessfully to the crown of Bohemia. But, by the treaty of Westphalia, his son regained the dominions which had formerly belonged to his family, and was created eight elector of the empire. Maximilian II. was put under the ban of the empire, but afterwards recovered his possessions; and his son, Charles Albert, in 1742, was raised to the imperial throne. On the death of his son, Maximilian Joseph, the house of Bavaria became extinct, and the electorate was suppressed. On this event Austria wished to annex Bavaria to her dominions, but her pretensions were opposed by Frederick of Prussia.

Bavaria was early and deeply involved in the French revolutionary wars. In 1799, Moreau found means to conclude a treaty for a cessation of hostilities, at a moment when Austria was threatened with invasion. The peace of Campo Formio increased the influence which France had sometime before begun to exert over her. After the victory of Hohenlinden, and the succeeding peace of Luneville, her subjection to France was complete; and as the reward of her alliance, she was, in 1806, elevated to the title of a kingdom, and extended by the accession of Tyrol, and several other provinces. In the same year, Bonaparte's step-son, Eugene Beauharnois, married Augusta Amelia, a princess of the reigning family of Bavaria. But the connection between these two countries, now strengthened by so many ties, was soon to be unbound by the operation of an unforeseen cause. The loss of her army in the horrible retreat from Moscow, in 1813, and the hatred inspired by the tyranny of Bonaparte, paved the way for this event. Soon after it she united and acted in concert with Austria. During the alliance against the lawless ambition of France, Bavaria, with an army of 60,000 men, powerfully joined the allies with a cordial co-operation: And on the success which crowned their exertions, and the negociations by which they were followed, Bavaria has recovered her rank and her independence among the states of Europe. She is to receive her share of the contribution money paid by France; the title of kingdom is confirmed, and the king is to possess the grand duchy of Wurtzburg, as it was held by the archduke Ferdinand of Austria, and the principality of Aschaffenburg, as it made part of the duchy of Franconia.

BAUHIN, John and Gaspard, two eminent botanists of the 16th century. John, the elder brother, was born at Lyons in France, in 1545, removed to Basil with his father's family, was appointed professor of rhetoric in that university, and for the last forty years of his life, which terminated in 1613, he was physician to the Duke of Wirtemberg at Montbelliard. The great botanical work, *Historia Plantarum*, &c. in 3 volumes folio, which was the labour of great part of his life, was not published till 1651.

Gaspard Bauhin, who was born in 1560, and died about the same time with his brother, practised as a physician at Basle; was at first professor of Greek, and afterwards of anatomy and botany, and was the author of *Pinax Theatri Botanici*, &c. or an index of the plants referred to or described by the ancient botanists. The names of John and Gaspard Bauhin, are still venerated by the lovers of botany, and hold a conspicuous place among those who contributed to revive and promote botanical knowledge.

BAUHINIA, Mountain Ebony, a genus of plants so denominated to commemorate the illustrious botanists, the brothers Bauhin, and belonging to the Decandria class.

BAXTER, Richard, an eminent English divine, was a native of Shropshire, and was born in 1615; and was not more distinguished by the extent and popularity of his writings, than remarkable for the scanty opportunities which he enjoyed of acquiring the elements of literature and science. Unaided by the instructions and discipline of any public seminary, he is indebted for his reputation to the force of his own genius, and the unceasing exertions of patient and laborious industry. His elementary studies were directed by his father, and other private individuals, in the progress of which early indications appeared of a contemplative mind, and a strong bias to literary pursuits. In his eighteenth year he visited London, with a recommendation to the master of the revels, for the purpose of obtaining some employment at court; but the bustle and pageantry of the scenes which he witnessed were ill-suited to his temper and thoughtful habits, and after a month's absence he returned with a double relish to his former studies. Admitted to ordination five years afterwards, he was first an assistant at Bridgenorth, and in 1640, he was appointed vicar, or stated preacher at Kidderminster, where he exercised his ministerial functions with the most exemplary diligence and remarkable success.

The civil dissensions which soon after distracted the kingdom, and involved it in scenes of bloodshed, drove him from his residence, and forced him to seek an asylum in various quarters of England. He joined the parliament, became chaplain of a regiment, and was always zealous and active in the suppression of turbulence; he seems to have been greatly respected by those in power, was employed to preach before the highest authorities; disapproved of revolutionary principles, and, after the restoration, he was appointed chaplain to Charles II. But although he was in much favour with that monarch, was consulted on the plans for settling the affairs of church government in Scotland, and was offered his choice of preferments in that part of the kingdom, and even, it is said a bishopric in England,—as he stood forward among the non-conformists, he suffered severely from the oppressive measures of the times, and was subjected to fines and imprisonment. He died in 1695, when he had reached his 76th year.

"Richard Baxter," says his biographer, "was a man famous for weakness of body and strength of mind; for having the strongest sense of religion himself, and exciting a sense of it in the thoughtless and profligate; for preaching more sermons, writing more books, and engaging in more controversies than any other non-conformist of his age. He spoke, disputed, and wrote with ease; and discovered the same intrepidity when he reproved Cromwell and expostulated with Charles II. as when he preached to a congregation of mechanics." His works were collected in four volumes, and have been abridged and published in a more compendious form. *The Saints Everlasting Rest; Call to the Unconverted*, of which 20,000 copies were disposed of in a single year, and which was translated into all the European languages, and even into the Indian tongue; *Poor Man's Family Book; Dying Thoughts, and Narrative of his own Life and Times*, are still popular; and the commendation of Baxter's works by Dr Johnson, is worthy of notice: "Read any of them," says the great moralist, "they are all good."

BAXTER, Andrew, a metaphysical writer, was born at Aberdeen about the year 1687, educated at the university of his native city, and seems to have been chiefly employed as a travelling tutor. As an author he is best known by his *Inquiry into the Nature of the Soul*, a work which attracted the notice of the learned. The later years of his life were spent in studious retirement at the sequestered village of Whittingham in East Lothian, in Scotland. He died in 1750.

BAYEN, Peter, a French chemist of some celebrity, was born at Chalons in 1725, studied pharmacy under an apothecary at Paris, and during the seven years war in Germany held the place of apothecary to the army. He was afterwards engaged at the public expence, to analyse the mineral waters of France; but although he was disappointed in the prosecution of this agreeable undertaking, he continued his chemical researches, and directed them to other objects; and he was fortunate in the discovery of the important fact, that the excess of weight gained by a metallic substance during calcination, and its change into the state of oxide, is owing to the absorption of air, and thus led the way to the final overthrow of the celebrated phlogistic theory. He died in 1798.

BAYEUX, a town of the department of Calvados in France, contains a population of about 10,000, and has some trade in leather. It is celebrated for a magnificent cathedral, and not less so for a famous piece of tapestry, executed by Matilda, the wife of William the Conqueror, and representing the history of the conquest of England. This precious relic, which is nearly 150 yards in length, and about two feet in breadth, was removed to Paris during the revolution, and engravings of it have been published in Ducarel's *Anglo-Norman Antiquities*.

BAYLE, Peter, the celebrated author of a historical and critical dictionary, was born 1647, at Carla in France, where his father was minister of a protestant congregation. The questions which, even in childhood, he proposed to his parents for solution, displayed a mind of superior capacity, and inspired the hope of future distinction. His father superintended his education till he was 19 years of age, and then sent him to the academy of Puylaurens, where, such was his love of learning, that he devoted even his hours of amusement to study. This over exertion induced a disease which threatened his life, and for some months interrupted his pursuits.

In 1669, he entered the university of Toulouse, was admitted a student of philosophy in the Jesuits' college, and to the inconsolable grief of his family became a convert to the Catholic creed. After a short stay he left Toulouse, and returned to his former faith; and his friends, perhaps dreading a relapse, sent him instantly to Geneva. Here his genius and his learning soon procured for him distinction and patronage. Mr Basnage, in particular, was zealous and active and persevering in promoting his interest. Through his recommendation he was tutor in three different families, which a discontented temper made him in quick succession unnecessarily exchange, complaining first of the seclusion of the country, and then of the unhonoured condition of a preceptor. When the philosophy chair of the Protestant academy of Sedan became vacant, Mr Basnage induced him to be a candidate, and, in a comparative trial, he took the place from all his competitors. He was elected to this office on the 2d November, took the oaths on the 4th, and began his lectures on the 11th of the same month, 1675. In this situation Bayle was associated with Jurieu, who was professor of divinity.

His lectures were much admired, and he was still rising in reputation, when, in 1681, the academy of Sedan, along with all the other protestant institutions in France were suppressed by the government. A few months after this event, a school similar to that of Sedan was instituted at Rotterdam, both for him and his colleague.

The great comet of 1680 gave rise to Bayle's first publication. Its appearance and eccentric motion had been viewed with alarm, as the harbinger of some signal calamity, and Bayle wrote a book to assure the world that comets afford no indication of divine displeasure. In defence of the Reformation, he next composed a criticism of Maimbourg's History of Calvinism. Jurieu wrote on the same subject, but was little noticed by the public,—a circumstance which is said to have excited in his mind a dislike to his rival which rankled into hatred.

In 1684 he commenced a literary and critical journal, entitled *News from the Republic of Letters*. This was deservedly a popular work; and in its second year, when he first inscribed it with his name, he was honoured with letters of approbation from most of the learned societies of Europe. Through the instigation of Jurieu, and the removal of his friends from power, Bayle was, in 1693, deprived of his professorship, with all its emoluments. But his own fortitude, and the esteem of the public, which was now eagerly testified in his favour, enabled him easily to sustain this calamity. The first volume of his Historical and Critical Dictionary, the scheme of which he had advertised some years before, was now in the press, and he was delighted with the leisure he enjoyed to superintend its printing. The moment this work appeared it was instantly bought up, and loudly praised. A new edition in four volumes was published in 1701. And soon after he sent a less elaborate work into the world, entitled, *Answers to the Questions of a Country Gentleman*, containing much of the lighter matter of the Dictionary.

From his first appearance as an author, Bayle was deeply involved in controversy, and the publication of his Dictionary served to increase the number of his antagonists, and to multiply the topics of debate. Jurieu, actuated by a malignant spirit, was always ready to decry whatever he advanced; Le Clerc and others disputed with him concerning the nature of things and the origin of evil; and the consistory of the Walloon church of Rotterdam cautioned him to be on his guard in future respecting the doctrines which he ventured to publish. He was busily employed in the composition of explanations, defences, and rejoinders, when he was seized with a decay of the lungs, of which he died on the 28th December 1707. He left some property to his relatives, and bequeathed some legacies to his friends.

Bayle was a man of frugal habits, and entirely devoted to study; he possessed a faithful memory, well furnished with all kinds of knowledge; but he seems to have had little skill in the management of his materials. His Dictionary, which is his greatest work, is thus characterised by himself:—"It is nothing else," says he, "but a confused compilation of passages tacked together,—a medley of proofs and discussions,—a criticism of many errors,—and a long train of philosophical reflections." Voltaire, who has given him a place among the illustrious authors that adorned the age of Louis XIV. says "he was a great logician rather than a profound philosopher." The universal adoption of the inductive method of philosophizing has now entirely exploded many theories on which Bayle expended a large portion of time and ingenuity; and it is hoped, that however men may speculate of *providence, foreknowledge, will, and fate*, they shall not, for the sake of opinions, the truth or falsehood of which mere reason can never determine, again involve the world in a war of words.

BAYONET, a short dagger, which is fitted to the end of the musket, so that the whole instrument may be used either for attack or defence, is supposed to derive its name from Bayonne, where, it is said, it was first manufactured, and was introduced into the French armies about the end of the 17th century. The use of the bayonet was revived and improved by the great Frederick of Prussia, and its powerful effects in the British and French armies during the late wars are well known.

BAYONNE, the largest town of the department of the Lower Pyrenees in France, is finely situated on the banks of the Nive and Adour at the place where they unite their streams, and about three miles from the sea. The town is defended by fortifications and a citadel. The population is about 13,000; the trade with Spain is considerable; woollen cloths, silks, cottons, and hardware, are exchanged for wool, wine, and oil; and masts and spars are conveyed down the rivers from the Pyrenees, to be exported to different parts of France. The Basque or old Biscayan language, and part of the dress, are still in use among the common people of Bayonne.

BAYREUTH, or BAREITH, is the chief town of the margravate of the same name in the circle of Franconia, is commodiously situated on the banks of three rivers, contains about 10,000 inhabitants, and was formery the seat of thriving manufactures.

BAZAR, a term of frequent occurrence in the narratives of oriental travellers, signifying the market places of eastern countries, and derived, it is said, from the Arabic word denoting *sale*, or *exchange of goods*. Separate edifices are appropriated to this purpose; and in the Persian and Turkish dominions some of the bazars or market places are spacious and magnificent structures.

BEAR. See *Ursus* under MAMMALIA.

BEARD, the hair which grows on the chin and contiguous parts of the face of adults. Among the ancient Greeks and Romans, at least in the earlier periods of their history, it was the practice to wear the beard, and it seems to have been an object of great veneration. The Greeks began to shave the beard about the time of Alexander the Great; and the Romans, in the 454th year of the city, when barbers were brought from Sicily for the purpose. It is curious to observe the diversity of caprice and fashion in cutting off the beard, or in permitting it to grow. Ecclesiastics have been sometimes enjoined to wear the beard as a mark of gravity, while at other times it has been forbidden; and in different churches opposite practices have prevailed. The Persian Mahometans shave the upper lip; but the Arabs, who are attached to the same faith, preserve their beards with the most scrupulous care. The Roman slaves wore the beard and hair long, and were only shaved when they obtained their freedom; but the Turkish slaves in the Seraglio are shaved as a mark of servitude. The Greeks shaved the beard, and cut off the hair as a token of mourning; but the Roman expression of sorrow and affliction was to permit the hair and beard to grow.

BEARN. See BERNE.

BEATON, DAVID, archbishop of St Andrew's and primate of Scotland, during the reign of James V. and the minority of Mary, was born in Fife in 1494, studied, under the direction of his uncle archbishop of St Andrew's, first at that university, and then at Paris, and entered into orders as soon as he had attained the canonical age. The Duke of Albany, regent of Scotland, appointed him resident at the court of France, and his uncle made him rector of Camp-

Beaton.

sie and abbot of Aberbrothick. On his return from France he was invested with the privy seal of Scotland, and employed, along with Sir Thomas Erskine, in the negociation of a marriage between King James and the daughter of the king of France. Their nuptials were solemnized at Paris, January 1537, and the royal bride was conducted by Beaton to the court of Scotland in the succeeding May. But as this princess did not long survive her marriage, Beaton was again despatched to France to obtain for the king, Mary, the daughter of the duke of Guise; a mission which he executed with success.

While he lived at the French court, he had the address to insinuate himself into the good graces of Francis, and to become master of the whole of his political system; a circumstance which enabled him afterward to rule his sovereign, and to raise himself; and by his entire devotion to the interests of the church, he obtained her dignities in great number, and in quick succession. He was consecrated bishop of Mirepoix, raised to the dignity of cardinal with the title of St Stephen, and soon after installed archbishop of St Andrew's and primate of Scotland.

On this elevation, the dark, designing, and bloody spirit of bigotry with which his mind was actuated began to disclose itself in the cruelty of his conduct. He summoned his clergy together, denounced the reformers as heretics, and proscribed many of the nobility. But the intervention of the king's death saved them from suffering, and diminished for a while the archbishop's power. After this event, he exhibited a document bearing the late king's signature, nominating himself, the Earls of Argyle, Huntly, and Arran, joint regents of the kingdom during the long minority of Mary. Historians assert that this paper was a forgery. But it did not serve his ambitious purposes; for Arran was chosen regent, and the archbishop was imprisoned in the castle of Blackness. But he soon obtained his liberty, was re-admitted into the council, promoted to the office of chancellor of the kingdom, and appointed the pope's legate in Scotland. With this accession of power he recommenced his persecution of the reformers. George Wishart, a celebrated preacher among the protestants, soon became his victim; through his means he was condemned to the flames; and the cruel cardinal, with a barbarous joy, beheld his martyrdom from the windows of his own castle.

But he had now incurred a general detestation, and the hand of the assassin was at hand to terminate his wicked career. Norman Lesley, son of the Earl of Rothes, with about sixteen associates, seized on his castle in the morning of the 29th May 1546, and having rushed into his chamber they dispatched him with their swords, and suspended him over the very window whence he had lately witnessed with such savage satisfaction the calm and resigned death of Wishart.

Cardinal Beaton was a man of great talents, which were well fitted for public business; but he had little learning, and still less virtue. His pride was overbearing, his ambition was unbounded, his manners were polluted, and his bigotry was bloody. While he lived he commanded great influence, amassed great wealth, and left a numerous illegitimate offspring.

Beattie.

BEATTIE, James, a distinguished author, both in poetry and prose, was born at Laurencekirk in the county of Kincardine in Scotland, in October 1735. Death deprived him of his father in early childhood, a loss which the fraternal affection of his brother David, then in his 18th year, greatly alleviated. The parochial school of Laurencekirk, which had acquired a high degree of celebrity from Mr Ruddiman, of philological celebrity, formerly its master, was at that time taught by a Mr Milne, a man of classical information. Under him young Beattie commenced his education, and was initiated in the knowledge of Greek and Roman literature. In 1749 he offered himself a candidate for one of the bursaries, or small annual stipends, in Marischal college, Aberdeen; which, after a comparative trial with the rest of the competitors, was bestowed on him as the reward of superior merit.

Having pursued his studies for four sessions, and completed the course prescribed by his college, he was admitted to the degree of master of arts; and, in consequence of the reputation for learning which he had already acquired, he was soon after elected parochial schoolmaster of the parish of Fordoun, adjacent to that of his nativity; a situation humble and secluded; yet most favourable for confirming his studious habits, and for maturing his poetical genius. Here he spent five years, procuring the grateful confidence of his employers by a diligent and able discharge of his duty; commanding the respect of the neighbourhood, by the number and the nature of his attainments; and gaining the love of all his associates by the purity and gentleness of his manners.

In 1757 he was an unsuccessful candidate for the office of usher in the grammar-school of Aberdeen; but on a second vacancy in the following year he was invited to accept of it, with the assurance of being preferred to the rectorship when that situation, then held by an old man, should become vacant. He now returned to Aberdeen, the seat of his Alma Mater, with which every man of genius has so many pleasing associations; and as he had himself profited under her fostering influence, he was, to his own amazement, elevated to the rank of sustaining her character for learning and science, by being appointed, through the interest of his friends, to the professorship of moral philosophy and logic in the year 1760, and the 25th of his own age.

At an early period he had begun to publish little pieces of poetry through the medium of the Scots Magazine, and the applause which had been bestowed on those juvenile productions encouraged him to collect them into a volume; he also published, about the same time his Essay on Poetry and Music; a work which forms an excellent introduction to the study of criticism, and which, previous to its publication, had been read and approved of in a literary society, of which Drs Reid, Campbell, Gerard, and other learned men connected with the university, were members, and Mr Beattie's constant companions. In 1767 he married Miss Dun, the only daughter of the rector of the grammar-school of Aberdeen. His union with this beautiful and accomplished young lady, which was formed under the auspices of ardent and mutual affection, and which opened a fair prospect of great and long felicity, proved, in consequence of calamities as unforeseen as they were severe, a source of bitter and heart-rending anguish.

The course of Mr Beattie's academical lectures led him to investigate the principles of human thought and action, and to discuss the questions which a subject so interesting had suggested; and, alarmed at the pernicious progress of infidelity, he formed the resolution of endeavouring to demolish the towering system of scepticism, which Hume and Berkely had built on the ideas of Aristotle, by shewing that it rested on no better foundation than a mere assumption, destitute of evidence. With this design, he published in 1770, his *Essay on the Immutability of Truth;* a work which quickly brought him a great accession of celebrity. In England, especially, it was hailed by the friends of revealed religion, and of the certainty of human knowledge, as well as of human obligation, as an opportune and effectual refutation of error. It was loudly applauded for the elegance of its composition, the perspicuity of its arrangement, and still more for the utility of its tendency. The friends and admirers of Mr Hume, indeed, then living in Edinburgh, regarded the whole as a personal attack on that elegant author, dictated by malignity; Dr Priestley also, and some others in England, found fault with its principles; but the hoarse murmurs of censure and dissent were little heard or regarded, amid the clear and continued peals of applause with which it was received; and so rapid was its sale, that a new edition was quickly put to the press. In the same year he published the first canto of the Minstrel, the design of which, as explained by himself, "was to trace a poetical genius, born in a rude age, from the first dawning of fancy, till that period at which he may be supposed capable of appearing in the world as a minstrel, or itinerant musician;—a character, which, according to the notions of our forefathers, was not only respectable but sacred."

On his first visit to London, Mr Beattie was unknown, and of course unnoticed; but when, in the autumn of 1771, he spent some time in that city, the reputation of his great talents and elegant taste, exerted in the cause of truth and virtue, opened to him a ready access into the most select circles of literary and scientific society. At the house of the celebrated Mrs Montague he met the most distinguished characters of the age. And during a subsequent visit, so general was the interest which his works had excited, that he was enabled to enrol among the number of his acquaintances and friends most of the learned men of London, many of the dignitaries of the church, some of the peers of the realm, and even the king and queen of the country. The university of Oxford conferred on him the degree of doctor of laws; Sir Joshua Reynold's painted his portrait; and government bestowed on him an annual pension of L.200.

But the beneficence of his friends in England had not yet exhausted itself. He had often been solicited to take orders in the church, with the assurance of preferment; and, to tempt his compliance, a living worth L.500 a year was offered him in 1774. But this flattering offer, as well as a professorship in the university of Edinburgh, he declined, lest it should be said he had written under the influence of mercenary motives, and he should farther provoke the spirit of opposition, which had already displayed itself—circumstances which tend greatly to enhance his character. From this time Dr Beattie was employed in the discharge of his academical duties, and in raising a reputation already proudly pre-eminent, by additional publications. But his days of delight were now drawing to a close;—the irritability of Mrs Beattie's nerves, and the caprices of her temper, arising from a mental malady inherited from her mother, and which at last subsided into settled insanity, had for many years greatly interrupted his domestic tranquillity. His eldest son, an amiable and an accomplished youth, who had been associated with him as his assistant and successor in the college, was seized by a consumption, which, after a lingering illness, brought him to the grave just as he had attained the verge of manhood. His afflicted father, inconsolable, indulged his grief by drawing up an account of his too short life, by inscribing an epitaph on his tomb, and by dreaming of the grave which lay beneath. The death of his youngest son, in 1796, left him childless; and a stroke of the palsy, which nearly deprived him of speech and motion, crowned his calamities. After a long period of helpless imbecility, death, on the 8th of August 1803, put a period to his sufferings. He died in the 68th year of his age, departing in peace, in the hope of immortality and happiness.

In personal appearance, Dr Beattie was of the middle size, strongly made, and inclining to corpulency. The complexion of his mind will be found in his works, which disclose the poet and the philosopher, the good man, and the true Christian. His Minstrel is a poem remarkable for simplicity and sweetness of language, for purity and pathos of sentiment, and for richness and truth of description. And a most interesting piece of information is, that in the character of Edwin he has delineated himself as he was in his younger days. "I have made him (he says, in one of his letters) take pleasure in the scenes in which I took pleasure, and entertain the sentiments similar to those of which, even in my early youth, I had repeated experience." His prose writings are voluminous. Of these, his Essay on Truth,—on Poetry and Music,—on Laughter and Ludicrous Composition,—on Classical Learning,—on Memory and Imagination,—on Dreaming,—on the Theory of Language,—on Fable and Romance,—on the Attachments of Kindred,—and his Evidences of Christianity, and Elements of Moral Science, display many instances of a vigorous understanding, of a discriminating judgment, of extensive information, of sound criticism, and of sincere and unaffected piety, set off with an elegant and animated stile; so that his works are, perhaps, as well fitted as any in the language for initiating the young student in the various branches of mental philosophy. In his Essay on Truth he has been charged with railing rather than reasoning, and with having interlarded his language too profusely with the pungency of acrimony for the uninterrupted coolness becoming a philosophical discussion. But in this (whether defensibly or not is a different question) he acted from principle, not from passion. He viewed his antagonists in the light that we view the thief or the robber, who endeavours to deprive us of our property; and conceiving that they had intentionally attempted the most irreparable of injuries, he was of opinion that their attacks ought to be repelled with a warm earnestness of manner. But whoever will read his letters on this subject, contained in Sir William Forbes's Memoir of his Life, will soon be satisfied that he was incapable of cherishing a hostile disposition in his heart.

BEAVER, a remarkable animal, on account of its singular habits, and the value of its fur in the manufacture of hats. See *Castor*, under MAMMALIA.

BEAUMARIS, the chief town of the isle of Anglesea in South Wales, stands at the north entrance of the strait of Menai, consists of two spacious streets, includes a population exceeding 1500, and is 254 miles north-west from London. The harbour affords safe and commodious anchorage to ships in six or seven fathoms water; but the trade is less considerable than in former times. The castle was built in 1295 by Edward I. to overawe the inhabitants; and from that time the town dates its origin as a place of importance.

BEAUMONT and FLETCHER, two celebrated English dramatic writers, whose names are always associated as the joint authors of a great number of plays which long kept possession of the stage, flourished in the early part of the 17th century. More than 50 separate pieces were the fruits of their united labours in this singular literary copartnery. A folio edition of their plays was published in 1679, another in 1711, in seven volumes 8vo., a third in 1751.

Francis Beaumont was descended from an ancient family in Leicestershire, and was born about the year 1586. His father and grandfather held high official situations in the legal establishment of the country. The latter was master of the rolls, and the former was one of the judges in the court of common pleas. Young Beaumont had the benefit of an university education at Cambridge, and was admitted a student in the Inner Temple; but it would appear that he had early abandoned the pursuits of law for the more attractive charms of the dramatic muse; for he died in 1615, before he had completed the 30th year of his age.

John Fletcher, the friend and poetical coadjutor of Beaumont, was the son of the bishop of London, was born in 1576, and was also educated at Cambridge, where he was distinguished by great proficiency in his studies, and was reputed an accomplished scholar. When he had reached the 49th year of his age, he fell a victim to the plague which ravaged the metropolis in 1625.

BEAUSOBRE, ISAAC DE, an eminent French protestant divine, was born at Niort in Switzerland in 1659, and was descended from a family which had fled from France about the time of the dreadful massacre of St Bartholomew in 1572. He was educated at the college of Saumur, and at the early age of 22 was appointed minister of a protestant congregation in France. About three years after his admission, severe measures were adopted against the protestants, and his church was shut up by an order of government; but an excess of zeal led him to break off the royal seal, and, to avoid the consequent punishment, he fled first into Holland, and finally, in 1694, he found a safe asylum in Berlin, which became the fixed residence of his future life. His talents and acquirements as a man of learning and a preacher, soon raised him to merited distinction. He was appointed royal chaplain, inspector of the French college, and superintendant of the French churches of the diocese. He died in 1738, at the venerable age of 80. His principal works are, a *History of the Reformation*, which occupied 40 years of his life, and was published at Berlin in 1784 and 1785; the *Critical History of Manichæus and Manicheism*, an elaborate and profound disquisition. His sermons were peculiarly distinguished for original thinking, elegant diction, and appropriate and forcible illustration.

BEAUTY, is that quality or condition of objects by which they are fitted to excite agreeable emotions or pleasing ideas in the mind. The term appears to have been originally applied to *colours*, but was gradually extended to other physical qualities, and in modern times embraces almost every thing, whether material, intellectual, or moral, which occasions a certain feeling of complacency and tenderness, when contemplated by the understanding. Thus we speak with equal freedom of the beauty of a carnation, a fine woman, a spaniel, or a lap-dog, a piece of music, a mathematical theorem, a philosophical discussion, the self-denial of Scipio, or the philanthropy of Howard. What is there common to all these cases, and a thousand more, which can vindicate the employment of the expression, and the application of its kindred epithet, beautiful? or, on the supposition that there is really nothing common to them, what is that peculiar affection of mind which is excited on so many very different occasions? These are among the most intricate questions in metaphysical science, or, to use a more appropriate phrase, respecting the knowledge of human nature, and have received almost as many answers as there are diversities of character in mankind,—a clear evidence, it is conceived, of gross and very general misunderstanding of our constitution, and of the substitution of mere reasoning, conjecture, hypothesis, and partial observation, in the room of deliberate and circumstantial inquiry. A very superficial view of the ingenious theories and splendid speculations on this subject, or, at once to characterise them, *beautiful* absurdities which have successively jostled one another out of the schools, would be sufficient to appal any man of common sense, who had *notwithstanding* a little anxiety to be informed by the learned why he is pleased with some things and not with others, and to ascertain the reason of his neighbour and himself so frequently disagreeing about the shape of their hats or the colour of their waistcoats, though they are perfectly of the same mind in politics, and express equal admiration of their parish church. But an enumeration of errors is not unimportant, if any way calculated to shew the vanity of dogmatism, and to deter genius from the misapplication of labour.

Theories.—The first notion of beauty, or *theory of the beautiful*, we shall notice, is that which conceives this quality to consist in utility or fitness, that is, the

Beauty.

suitableness or adaptation of objects to the purposes for which they are designed. This is a very ancient opinion, and may easily be accounted for. The savage who had been ingenious enough to erect a hut which defended him from the inclemencies of the weather, or to hollow out the trunk of a tree, so as to enable him to cross the river which limited his range, or even to sharpen and point the fragment of a rock, by which he was emboldened to assail the tusk-armed inhabitant of the forest, would naturally contemplate the product of his skill with feelings of delight and pleasure. His conception of the beautiful, it is highly probable, would be almost coexistent with his success, and the very colour and form of his dwelling, his vehicle, or his instrument, would ever after be identified in his mind with the pleasurable consciousness of something excellent. It may be freely granted, therefore, that the perception of fitness and utility is reconcileable with the notion of beauty. But that this does not exclusively constitute beauty is certain, from the simple fact, not to enter on any process of reasoning, that many things are thought beautiful, that is to say, occasion the emotion of beauty, which are totally unfit for any one valuable purpose whatever. Besides, it is no less true, and no less destructive of this theory, that in civilized life there is an immense number of objects, which, though abundantly useful, are far enough from exciting any agreeable ideas.

Unity of parts.—Very nearly allied to this opinion, and liable to modifications of the same objections, is the theory which resolves beauty into the expression of unity, that is, concord, or harmoniousness of parts, implying design and determination. Perhaps the notion maintained by some of the followers of Leibnitz, that beauty consists in perfection, is not very dissimilar. Father Buffier is the chief advocate of this last system, which professes to determine a very intricate question, long debated in the schools, what is the *standard* of beauty? The ostensible reply is, that which is most common to all the individuals or members of a species. But it is miserably defective,—many things being reckoned beautiful which are neither common nor yet perfect; and, on the other hand, the things or qualities of things which are most common to individuals, to species and genera, being in reality least productive of the emotions of beauty.

Arrangement.—Another theory asserts beauty to consist in the symmetrical arrangement and relation of parts. This is strikingly exemplified in some of the works of nature, and many of the productions of art, but obviously excludes an immense variety of objects which most men have agreed to be beautiful. The doctrine of certain proportions constituting beauty, without respect to any ultimate design or purpose, is a branch of this system which has long been popularly admitted in architecture. But its influence has rapidly declined of late years, and is now almost entirely confined to the more vulgar practitioners of that noble art.

Of five elements.—A combination of some of the preceding theories, with slight additions, has been attempted by some foreign writers, who determine beauty to be made up of five elements, variety, unity, regularity, order, and proportion.

2

Hutcheson's theory.—Dr Hutcheson of Glasgow broached the idea that beauty was nothing else than the union of variety and uniformity, as perceived by a peculiar internal sense. This, too, had its day, totally supposititious as it was, and in reality opposed to the result of the most familiar observations. But in our judgment, it is the appeal to facts as to the objects themselves which are generally considered beautiful, that decides against his system, and not the mere circumstance of his proposing the introduction of an additional faculty in order to explain the phenomena. Dr H. has the merit, not immaterial, we apprehend, of venturing beyond the precincts of scholastic philosophy, and anticipating in principle, though by no means in object, one of the peculiarities of an extensive system, which has threatened, since his time, to bring about a total revolution in metaphysical science. We allude to the labours of Gall and Spurzheim, of which we shall elsewhere have occasion to speak more particularly.

Hogarth's.—Hogarth, the painter, considered variety as the most material constituent of beauty. But he admitted the influence of fitness, uniformity, simplicity, intricacy, and quantity. This ingenious but whimsical man, is remarkable for having pitched on a certain curve, which he has chosen to denominate the *line of beauty*. An approximation to it is unquestionably found in many objects capable of giving agreeable emotions. But the pleasure derived from them as objects of taste, is, in all probability, resolvable into the notions of ease, tenderness, and delicacy, which they occasion. Now these are utterly unsuitable to the character of other objects, which are nevertheless thought beautiful. This branch of the theory, therefore, is erroneous, and indeed the whole of it is partial, incomplete, and unsatisfactory.

Burke's.—No less a man than Edmund Burke blundered egregiously in fabricating a *theory of beauty*, though certainly very successful in demolishing some of the opinions which he meant to supplant by his own invention. Beauty, according to him, is a certain quality, or a combination of qualities, in bodies, by which the mind is operated on through the medium of the senses, and a kind of languor, or relaxation of fibres is produced. Smoothness of surface, delicacy of texture, gradual variation of outline, and smallness of size, as might naturally be expected, are some of the physical properties or conditions of bodies connected with the quality assumed in this theory. It is almost needless to say, that this is a very imperfect enumeration of the sources of the beautiful. But even though it were complete, it would as much fail to explain what beauty is, as an enumeration of the occasions on which gout or an ague take place would be insufficient to point out the nature of those diseases. Moreover, the supposition of a relaxation of fibres is confirmed in only a very few of the cases in which the emotions of beauty are experienced.

Diderot's.—It is, if possible, the still more erroneous and fantastic opinion of Diderot, that the beauty of objects consists in the power of exciting in the mind the idea of *relation*; or, in other words, that our conception of the beautiful is identical with the act of comparing the relations between different objects, and is of variable strength in proportion to the number and distinctness of the relations discovered. Among the objections to this theory, it is perhaps enough to mention, that the discovery of relations is not always even a source of pleasure, so far from being itself the very essence of beauty; and that there are many objects which instantaneously excite the agreeable emotions of taste, in certain minds, or on persons of certain character, although there do not take place in them the slightest effort or wish to form any comparisons whatever; farther, if this theory were true, it follows, that many ugly or positively disagreeable objects should necessarily become sources of pleasure, inasmuch as they are equally prolific of relations with those which bear a very different character.

Mr Alison's.--The cautious examination of these and other theories, and attentive consideration of his own experience, have conducted Mr Alison to a very different view of the nature and sources of beauty. According to this eloquent writer, beauty is not the result of any of the qualities of bodies, simply contemplated as such, but of these qualities as invested with new and totally disimilar powers, by association with our own affections, emotions, and ideas. The mind, in fact, appears to be considered in this system as forming a connexion with material qualities, in the progress of its intercourse with the external world, and to be occasionally engaged in operating on itself, when these qualities are either directly presented to the senses, or are brought before the imagination by a process of memory. Such, in few words, is the essence of a theory, which, of late years, has obtained the greatest currency in the literary world. It is stated, exemplified, and defended in a very elegant and pleasing manner, in the "Essays on the Nature and Principles of Taste," to which we must necessarily refer the reader. Mr Payne Knight, Mr Dugald Stewart, and the editor of the Edinburgh Review, have lent their support to its most peculiar features, but with sundry modifications, some of which indeed appear not a little at variance with the fundamental proposition. This is particularly the case with the first-mentioned author, who contends for the existence of some portion of beauty at least, altogether independent of the associating principle. Against this supposition, the reviewer has inveighed as quite heretical; though he himself, of course, admits the power of pleasing our senses to exist in certain qualities of bodies, as, for example, colour and sound.

Objections.—To a theory, supported as this has been on such high authority, and rendered captivating as it is by a felicity and splendour of decoration beyond all precedent in metaphysical compositions, we shall not scruple to object. The grounds of our demurring shall be stated in the form of distinct propositions, which we leave for the reader's consideration, rather than assume the more dignified but less modest appearance of an essay professing to decide the question.

In the first place, this theory seems to us too much confined to material objects, and to exclude the consideration of two very important and scarcely less extensive classes of objects, those of an intellectual and moral nature, which are notwithstanding perfectly well known to be highly productive of beauty.

2dly, A principle is assumed in this theory, which, though admitted in certain metaphysical writings to be a part of our constitution, is, in our judgment, nothing else than a form of expression to denote a series of facts, and cannot be proved to have any existence in the mind as a separate or distinct faculty. We mean the association of ideas,—which, according to this theory, the mind not only has the power of exercising within itself, if the phrase be allowed, but also of extending, in some incomprehensible manner, to external objects. The language of one of the advocates of this theory, when alluding to this power, even granting something in the way of poetic licence, is singularly incautious: "The beauty which we impute to outward objects, is nothing more than the reflexion of our inward emotions, and *is made up entirely of certain little portions of love, pity, and affection, which have been connected with these objects, and still adhere as it were to them,* and move us anew whenever they are presented to our observation." With equal propriety might a physiologist assert, that the nutritive quality of certain bodies used as food, is nothing more than the reflexion of our own internal functions, and is made up entirely of certain little portions of cartilage, membrane, and muscle, which have been connected with these aliments, and still adhere as it were to them, when they are taken into the stomach!

3dly, The theory appears inconsistent with itself. The fundamental proposition with which it sets out, that there is no beauty in the external objects themselves, but merely as they are operated on or new-modelled by association, we imagine excludes beauty altogether, except in so far as our own emotions, affections, and ideas are concerned. In this respect it strongly resembles the hypothesis of Bishop Berkely, by accurately reasoning on which one comes to the comfortable conclusion, that there is no external world at all, and that we have no satisfactory evidence of the existence of any thing but our own minds and the ideas which pass through them. To defer the emotions of beauty till certain associations be produced, and to affirm or imply that these associations are formed because of the antecedent or concomitant experience of something agreeable or pleasing, seems no less contradictory in itself as a logical proposition, than irreconcileable with daily observation.

4thly, We are in many cases totally unconscious of any association of ideas having a share in the production of the agreeable emotions felt when certain objects are presented to us. In other words, the theory does not always apply, even admitting that so far as it goes it is well founded. Here we may remark, it is freely granted that the consciousness of certain ideas, or trains of ideas, passing through the mind, is one source, and that a fruitful and powerful one, of pleasure. But, on the other hand, it is contended, that we are sometimes *instantaneously* impressed with emotions of beauty, consequently before such associations have had time to present themselves; and in other cases, it may be added, the simple emotions of beauty may be experienced in spite of associations, which, if given way to, would be totally subversive of them, and destructive of pleasure. The theory, therefore, though in part true, is inadequate to explain all the phenomena, and cannot, agreeably to the precepts of sound philosophy, be held as the proper solution of the question. In our judgment, a single exception, fairly sustained, is conclusive against its claims to the honour of a law of nature.

Other objections of minor, but not inconsiderable force, are purposely omitted for the present. We shall conclude with barely stating the outline of another theory, derived from a system formerly alluded to, though, as far as we know, not contemplated by its authors. It involves some subjects of an intricate and curious, but highly important nature, to which there will be opportunities of afterwards calling the reader's attention. The merest suggestion is all that can now be hazarded.

More plausible theory.--The human mind consists of various powers, faculties, propensities, and sentiments, each of which is dependent on a certain condition and exercise of an appropriate organ seated in the brain. The different organs are connected together in such a manner, that they may be operated on, or may operate, either separately, that is, each by itself, or conjointly, in any variety of combination. They are not of the same dimensions, intensity, or power in different individuals, nor are they any way proportioned to one another in the same individual. Hence the immense diversities of character among mankind, and the variable and varying conduct and experience of the same persons, in different circumstances, or in the same or like circumstances in different periods of life. It is a law of our constitution that these organs are affected, and consequently their respective powers, &c. &c. excited by impressions from without, and also by various processes carried on in the system, during the course of organic and animal life. It is equally a law of our constitution, for which we can assign no reason but the will of Him who made it, that of these impressions and impulses, if we may so speak, some are agreeable, others disagreeable, and that their corresponding results are, therefore, relished by us or disliked. The five senses afford us familiar, but equally inexplicable examples. Certain tastes, smells, sounds, *visibles*, &c. are pleasing and displeasing, sometimes in spite of our own wills, and, except in a few cases, without our being able to give any reason why they are either one or other. Our *internal senses*, so to speak, are quite in the same predicament. There are certain adaptations of external objects to them, taking this phrase to comprehend every thing that may be subjected to our minds, which are productive of agreeable emotions, and these are either confined to one organ, or embrace several organs, according to circumstances and the character of the individuals. It is the diversity of character, dependent on what has already been mentioned, that gives rise to the various associations of ideas, so much insisted on in the preceding theory; and on the same principles may readily be explained both the concord and disagreement of mankind as to the objects of taste. The theory now suggested, it is proper to remark, does not admit the existence of any general powers or faculties known under the names of judgment, memory, and imagination, according to the systems of the schools. In place of these, it is conceived, that each of the special faculties or higher powers of the mind has its own judgment, memory, and imagination; and that these are dependent, in some hitherto inscrutable manner, on the degree, and, perhaps, kind of activity, of the respective organ. The theory would restrict the term beauty, and, of course, several other terms which are often used when speaking of the objects and nature of taste, to those faculties and powers which are so endowed. These are as numerous as the peculiar qualities of bodies, and the moral and intellectual powers of the mind. Each finds pleasure and the beautiful in its appropriate object, and may excite some other power or powers of the mind. Farther, there is a system of supremacy and subordination among these powers, intended, and plainly pointed out by the hand that made us; and it is only in reference to this, and deducible from it, that we can decide on a standard of taste. Finally, this theory, while it not only leads to mutual forbearance in things indifferent, as a polite and convenient expedient, but absolutely enjoins it as a law of nature, nevertheless accurately and imperiously specifies its limits; nor is it its slightest recommendation, that it confirms the connexion of mankind with one another and with the world in which they are placed, and irresistibly demonstrates their entire dependence on Him who created all things, and " in whom they live, and move, and have their being."

BECCARIA, Giambattista, a celebrated electrician, was born at Mondovi, in Italy, in 1716, and having completed the elementary parts of his education, he repaired to Rome at the early age of sixteen, for the purpose of assuming the monastic habit; and being admitted to a religious order, he commenced a regular course of study to improve and extend his knowledge. The bent of his genius drew him off from scholastic subtleties, and led him to pursue the more useful path of physical science. When he had finished his studies he was appointed to teach belles lettres in the college of Urbino, and executed the charge with ability and diligence. But although he was an ardent admirer of classical literature, and produced some elegant specimens of Latin poetry, he soon after relinquished the seductive charms of the muses, and devoted his labours to mathematics and natural philosophy. On these subjects he delivered lectures, first in the Royal college of Palermo and afterwards at Rome; and in 1748 he was appointed to the chair of natural philosophy in the university of Turin.

Beside other curious disquisitions in various departments of physical science, Beccaria entered deeply into the investigation of electrical appearances, and in 1753 published his Treatise on *Artificial and Natural Electricity*, which was translated into English in 1776. In the year 1774 he published the result of a laborious undertaking which he had completed ten years before. This was the measurement of a degree of the meridian in which he was charged by the celebrated astronomer Cassini with inaccuracy. On this subject, and on his Theory of Electricity, a controversy commenced; and in the latter period of his life he was a good deal occupied in defending his opinions.

The arduous labour and incessant fatigue to which he had been subjected in the measurement of the degree of the meridian induced a severe disorder, which in the year 1776 assumed an alarming appearance, and after repeated attacks, along with the accession of an intermittent fever, completely exhausted his strength under their accumulated pressure, and terminated his mortal existence about the close of the year 1781.

With all his talents and reputation, Beccaria enjoyed no great share of popularity among his countrymen. The coarseness of his manners was disgusting, and his excessive ambition of fame often excited jealousy. His seclusion from the world, which left him in ignorance of the ordinary modes of courtesy and forbearance, may perhaps in some degree account for his peculiarities. But the solid learning which he possessed, and the laborious researches in which he was engaged, raised him to a high rank among men of science, and procured for him the honour of being enrolled among the members of the Royal Society of London and of other learned bodies. Beside his favourite subject of Electricity to which a large share of his attention was devoted, he made improvements on the solar microscope, and on the pendulum, for the purpose of correcting the errors produced on the latter by its contraction and expansion from heat and cold, invented an ingenious formula for discovering the foci of lenses, made some curious remarks on the double refraction of Iceland crystal, and left behind him various treatises on astronomy and natural history.

BECCARIA, Cæsar Bonesana, Marquis of, the celebrated author of a work on *Crimes and Punishments*, was born at Milan in 1735, was initiated in the elements of literature and science at the Jesuits college in Parma, and afterwards devoted himself to mathematics, and particularly to the study of jurisprudence. His first publication was on the debased state of the current coin of the Milanese states; and at no very distant period it was followed by his *Treatise on Crimes and Punishments*, the most elaborate and most popular of all his literary productions. The Marquis Beccaria was also the author of various other works, chiefly connected with political economy, and he held various official situations in the state. He died in 1793.

BECHER, John Joachim, one of the earliest systematic writers on chemistry, was a native of Spires in Germany, and was born in 1625, was fortunate in being promoted to high official situations, as physician to the elector of Mentz and the elector of Bavaria, and counsellor to the emperor; and it is said that he was furnished by those distinguished personages with the means of carrying on his experiments in natural philosophy and chemistry. But he seems to have been of a restless disposition. His residence was often changed while he remained on the continent, and at last he repaired to London, where he died in 1682. His learning was various and extensive; and he was the first who applied chemistry in explaining the composition and relations of bodies. He was the author of numerous works on chemical subjects, the chief of which are his *Physica Subterranea*, and *Institutes of Chemistry*, all written in Latin. See *Boerhaave's Chemistry*, translated by Shaw.

BECCLES, a town of Suffolk in England, stands on the banks of the Wavenay, includes nearly 3000 inhabitants, who are only occupied in domestic manufactures, is composed of several streets diverging from a spacious central area, and, from the conspicuous station of the church, an elegant Gothic structure, exhibits a fine view of the windings of the river and the surrounding country. Beccles is 15 miles south-west from Yarmouth, and 108 miles north-east from London.

BECKET, Thomas A, archbishop of Canterbury, whose struggles for the supremacy of the church, and tragical death, form a striking feature in the history of the times, was the son of Gilbert Becket, sheriff of London, and was born in 1119. The story of his parents, if true, has an air of romance. The father, while on a pilgrimage to Jerusalem, was taken prisoner by the Saracens, and sold as a slave. The daughter of the master whom he served, conceived an affection for him; when he escaped from bondage she accompanied him to London, was converted to Christianity, and became his wife. Thomas a Becket was the offspring of this marriage. With powerful talents and great industry, he completed the requisite studies for the clerical profession, to which he was destined, at Oxford, Paris, and Bologna; and, on his return to England, his superior acquirements and prepossessing appearance attracted and secured the notice and friendship of the archbishop of Canterbury, from whom he obtained lucrative and distinguished preferment. The successful termination of a mission to Rome on the affairs of the church, proved his abilities in the management of public affairs; and a recommendation from the archbishop to Henry II. procured for him the favour of that monarch, by whom he was elevated to the high dignity of lord chancellor, loaded with civil and ecclesiastical offices, and entrusted with the education of the heir-apparent of the crown. His immense revenues enabled him to live in the most princely stile, to keep a numerous band of retainers, and to display a more magnificent expenditure than any subject in the kingdom. Ambitious of fame in military affairs and martial exercises, with a train of knights he accompanied the king in an expedition to France, and gave proofs of his skill and bravery in active warfare; and hunting and horsemanship were his favourite amusements. But with this accumulation of riches, honours, and distinction, his attachment to his sovereign, devotion to his interests, and gratitude for such unexampled favours, continued unabated.

The growing power of the church and its rapid encroachments on civil authority had greatly harassed the reign of Henry. In the vacant see of Canterbury he contemplated an opportunity of imposing a restraint on the increasing evil, by filling it with a submissive dependent of his own, and Becket probably at the same time saw a new scene of ambition opened before him. But on his elevation to the primacy, in 1162, he was no longer the servile flatterer and pliant courtier. Withdrawing from the world, he relinquished the chancellorship, subjected himself to the severest mortifications, and by his boundless charities commanded the highest respect and admiration; but he was no less jealous of the prerogatives

Becket.

of the church than his predecessors, and would suffer no interference of the civil power in the punishment of the clergy, even when they were guilty of the greatest enormities. Becket, with the other dignitaries of the church, had assented to the *Constitutions of Clarendon*, regulations drawn up for defining the powers of the clergy, and had solemnly sworn to maintain and observe them; but the pope's refusal to ratify this deed was accompanied with a dispensation to relieve him from the obligations of his oath. His renunciation was followed by an open rupture with his sovereign. He was compelled to leave the kingdom, and after a residence of six years on the continent, he was restored, through the mediation of the pope and the king of France, to his dignity and power. Reinstated in the archiepiscopal chair, he was not more accommodating than before his exile; and the king, indignant at his proceedings, is reported to have said, that "he was an unhappy prince, who maintained a great number of lazy insignificant persons about him, none of whom had gratitude or spirit enough to revenge him on a single insolent prelate, who gave him so much disturbance." Four barons impressed with these words, and determined to force the archbishop into submission, hastened to Canterbury, and found him at vespers in the church. Refusing to listen to their remonstrances, and defying their vengeance, he was slain as he knelt at the altar. His death happened on the 29th of December 1170, and in the 52d year of his age.

Few events have made a deeper impression on the public than the murder of Becket. Henry seemed to express the utmost regret at the barbarous deed, and dispatched a solemn embassy to Rome to wipe off the imputation from himself, and to conciliate the papal court. The church of Canterbury was regarded as polluted with the crime, and divine service had ceased to be performed in it for nearly a whole year, till it was reconsecrated by the command of the pope. Two years afterwards Becket was canonised; and in the succeeding year, when Henry returned to England, he submitted to penance, as a testimony of his sorrow and regret for the murder of the prelate. When he approached the church, he alighted from his horse, and in the habit of a pilgrim walked barefooted to the tomb of Becket. Having prostrated himself, and continued for a considerable time in prayer, he submitted to be scourged by the monks; and kneeling upon the bare stone he spent the whole day and night without refreshment. After the lapse of 50 years from the time of the murder, the body was taken up in the presence of Henry III. and a great concourse of the nobility, and deposited in a magnificent shrine erected by Langton, archbishop of Canterbury. The reputation of the miracles performed at his tomb, attracted pilgrims from all quarters, by whom it was enriched with the most precious gifts and costly offerings. Even foreign potentates were found among the devotees. Louis VII. of France performed a pilgrimage to this far-famed tomb, and bestowed on the shrine the most valuable jewel in christendom. The body was annually raised by the monks, and the day on which this ceremony was observed, designated *the day of his translation*, was kept as a general holiday. Every 50th year a grand jubilee, which lasted fifteen days, was celebrated to his honour; to all who visited his tomb at that time plenary indulgences were granted; and it is said that 100,000 pilgrims have been entered on the register at a time in Canterbury. A curious record is preserved, which shews the estimation in which St Thomas a Becket was held, by the disproportionate amount of the offerings made at the altars of Canterbury. In one year, at the altar of God, the sum offered was L.3, 2s. 6d. at that of the Virgin L.63, 5s. 6d. and at St Thomas's L.832, 12s. 3d.; and in the following year no offering whatever was made at the altar of God, the sum presented at that of the Virgin amounted to L.4, 1s. 8d. but at St Thomas's it was L.964, 6s. 3d. Henry VIII. pillaged this celebrated shrine of its rich treasures, cited the Saint to appear in court, and to be tried and condemned as a traitor, commanded his name to be expunged from the kalendar, and ordered his bones to be burned, and the ashes to be dispersed in the air.

Beckmann.

BECKMANN, JOHN, the ingenious author of a curious treatise on the origin and progress of economical and mechanical arts, was a native of the electorate of Hanover, and was born in 1739. By his father's death, when young Beckmann was only seven years old, the care of his education devolved on his mother; and having completed the elementary branches of literature, he was sent to Gottingen to finish his studies for the clerical profession, to which he was destined. But he was more devoted by inclination to physical science than to theological learning; and in 1762, on the recommendation of the celebrated geographer Busching, who then presided in the Lutheran academy at St Petersburgh, he was appointed professor of natural philosophy in that seminary. The harmony of the institution was soon after disturbed by dissensions, which induced Beckmann to relinquish his situation. Returning to his own country through Sweden, he made himself acquainted with the mode of working its valuable mines, and on his visit to Upsal he experienced much of the hospitality and friendship of the illustrious Linnæus.

The appointment to the professorship in the university of Gottingen, which he retained through life, took place in 1766. Beckmann seems to have possessed a peculiar facility of talent in the developement and application of science to the arts of life. It was the professed object of the institution which he now superintended, to arrange and illustrate the various departments of political and domestic economy. The novelty and interest of his lectures attracted crowded audiences; his instructions were not merely general descriptive details; but in the visits of his pupils, whom he accompanied to the work-shops of the artisan and manufacturer, he explained and elucidated the minutest processes.

In compliance with a laudable practice, which had been long established in the University of Gottingen, that every public teacher must be acquainted with what has been done throughout Europe in his own department, Beckmann entered on the arduous task of collecting information on the multifarious subjects of his lectures;—a task, the extent of which is only limited by the bounds of human knowledge, and from which an ordinary mind would have shrunk in despair;—a task which his singular talents for research, his peculiar powers of elucidation, and unwearied industry, have enabled him to accomplish in the most successful manner, and the fruits of which have appeared in *The History of Inventions and Discoveries*, one of the most curious productions ever presented to the world. In this elaborate collection, the origin of the arts of life is marked as distinctly as can be ascertained by historical evidence, and their progress is traced through ancient and modern times to their present most improved state. No reader can be disappointed in the perusal of this work, of which an English translation has been published. Beside various Memoirs in the Commentaries of the Royal Society of Gottingen, Beckmann was engaged in the latter years of his life in the *History of the Earliest Voyages in Modern Times*; and that part contributed by him bears the marks of his usual industry and research. He died in 1811; and, to the praise of his distinguished literary attainments, must be added the excellence of his moral character, in which great candour and modesty, warmth of friendship, and the utmost condescension and affability to his pupils, were the prominent qualities.

BEDDOES, Thomas, a learned English physician and medical writer, was a native of Shropshire, and was born in 1760. His early education was conducted at private seminaries, and at the Free Grammar School of Bridgenorth, where he was greatly distinguished by a retentive memory, close application to study, and rapid progress in classical literature. An accident which befel his grandfather, and which terminated in his death, led young Beddoes, who was then only nine years old, to watch the progress of the affection, and to consider the means of cure employed, and is said to have fixed his choice of his future profession, while the interest and acuteness which he displayed as a feeling and sagacious observer, attracted the notice and procured for him the lasting friendship of the attendant medical practitioner. In his sixteenth year he was admitted a student at Oxford, and in his literary exercises he soon acquired the reputation of an elegant classical scholar. About this time he began the French language; and when he entered on this study with no other help than a grammar and a dictionary, his reply to a friend who expressed his surprise at the boldness of the attempt, that in two months he would acquire a competent knowledge of it, and in which he actually succeeded, shews with what eagerness, facility, and perseverance he acquired languages; for with the same independent exertion he became master of Italian, German, and Spanish. But while he proceeded with ardour in the prosecution of general literature, he was not inattentive to the progress of physical science, and particularly to the brilliant discoveries in chemistry, which had just begun to dawn on the world. Natural history, especially botany and mineralogy, occupied his leisure hours during his college vacations.

Thus qualified, he repaired to London in his 21st year, to pursue the requisite studies for the medical profession; and while he was engaged in acquiring the knowledge of anatomy and physiology, he translated Spallanzani's *Dissertations on Natural History*, from the original Italian. In 1784 he fixed his residence in Edinburgh, and continued for three successive sessions to attend all the lectures in that celebrated seminary connected with his future destination in life; and within this period he translated and published Bergman's *Essays on Elective Attractions*, and superintended an edition of Scheele's *Chemical Essays*. Having been previously admitted bachelor and master of arts, he obtained, in 1786, the degree of doctor of medicine at Oxford; and having spent the succeeding summer in France, where he was fortunate in enjoying the acquaintance and conversation of the illustrious chemical philosophers, Lavoisier and Morveau, he was appointed, soon after his return, to the lectureship on chemistry in the university of Oxford. His lectures were instructive and popular, and drew together crowded audiences. Connected with his immediate pursuits, he published an Account of the Experiments of Mayow at Oxford in the 17th century, and to his curious researches has traced those discoveries which are the foundation of the science of modern chemistry.

But the residence of Dr Beddoes in this venerable seat of learning was of short duration. The dazzling scenes which the French revolution seemed at its commencement to hold out for the improvement and happiness of the world, could not pass unnoticed by an ardent and speculative mind. Beddoes was transported with the alluring prospect, and indulging in the political reveries of the day, took no pains to conceal opinions which ill accorded with the established modes of thinking of those with whom he associated. To this jarring of sentiment probably is to be ascribed his seemingly imprudent resignation of his lectureship. But the activity of his mind did not leave him unemployed; for about this time he published a treatise on mathematical evidence, and another on the cure of *Calculus*, *Consumption*, &c. with *Conjectures on other Objects of Physiology and Pathology*; and about the same time appeared his *History of Isaac Jenkins*, one of his most popular productions, in which he exhibits, under a fictitious narrative, the reformation of a habitual drunkard, and his return to sobriety and industry. The sale of 40,000 copies of this work in a short time, is a sufficient proof of the interest which it excited.

The establishment of a pneumatic institution for the purpose of patients inhaling certain kinds of air, with the view of curing diseases according to speculative principles suggested by modern chemistry, was long a favourite object with Dr Beddoes; and having surmounted many difficulties, he succeeded in his plan, and the institution was opened near Bristol in 1798. Its professed objects were not attained; but in the history of chemical science it will ever hold a distinguished place; for here, as the superintendant of the experiments, Sir Humphrey Davy commenced his brilliant career in the discovery "of the wonderful effects of *Nitrous Oxide*, or Gas of Paradise, on the system when respired." From the remarkable properties of this peculiar elastic fluid, the highest expectations were indulged of the benefits to be derived from this mode of conducting the cure of diseases; but it soon appeared that these hopes were visionary, and in the course of a few years the scheme was abandoned.

Beside the works already mentioned, Dr Beddoes was the author of a numerous list of treatises on medical subjects, and to most of them he has attempted to give a popular character to render them interesting and useful to the general reader, as well as to contribute to the improvement of medical education and rational practice. He was also the author of various political productions, a list of which will be found in Memoirs of his Life by Dr Stock. Dr Beddoes died in December 1808.

BEDE, or BEDA, usually designated the venerable Bede, one of the oldest English historians, was born at Wearmouth, in the county of Durham, in the year 672, was educated in the monastery of St Peter, and at the proper age was admitted to the priesthood. The greater part of his life was spent in a monastery near the mouth of the river Tyne, where he devoted himself to the exercises of religion and the pursuits of literature. In this retirement he composed his ecclesiastical history, a work which acquired him great reputation while he lived, and is still regarded of estimable authority. He composed a great number of other treatises on various subjects; he translated some parts of the Bible into the Saxon language; and his homilies were appointed to be read in the churches. He died in 735, and was buried in the church of his own convent, but his ashes were afterwards removed to Durham, and deposited in the same coffin with the mortal remains of St Cuthbert. The first collection of his works appeared at Paris in 1544, in three volumes folio, and the latest edition was published at Cambridge in 1722.

BEDFORD, an inland county of England, which has Buckinghamshire for its boundary on the south-west and west, Northamptonshire on the north-west and north, Huntingdonshire on the north and north-east, and Cambridgeshire and Hertfordshire on the east and south. The greatest length is estimated at 36 miles, and the breadth at 22 miles; the area in square miles exceeds 300, and includes about 300,000 square acres.

Bedfordshire presents a diversified surface of gently rising hills and low vallies. None of the higher grounds rises to any great elevation. The Chiltern hills, which skirt the southern extremity of the county, and traverse part of it, form the highest range, and are composed of chalk strata. The lower ridges consist of alluvial clay and sand, and branch off in various directions. In the uppermost stratum of chalk numerous layers of flints are regularly distributed. To this stratum, proceeding downwards, another body of chalk, harder and of a more solid consistence, and destitute of nodules of flint, succeeds. The thickness of the united chalk beds is not less than 400 feet, and below them are strata of chalk, marl, and a durable sand-stone. The alluvial clay is also of great thickness; and the beds of ferruginous sand, in some places of considerable extent, are from 150 to 180 feet thick. At the bottom of this stratum of sand are disposed the beds of fuller's earth, seven or eight feet in thickness, which have been long wrought in this and the neighbouring counties, for manufacturing purposes. In some parts of a clay stratum near the town of Bedford, thin beds of argillaceous schistus are met with, which are so strongly impregnated with bitumen as to burn like coal; and in the vicinity of the county town, beds of grey compact limestone appear, on which it is supposed the whole strata of the county repose. The inclination of the strata of Bedfordshire is to the south-east. A very large proportion of the soil of this county is alluvial, and composed chiefly of yellowish dark coloured clays. Peat soil is predominant in the bottoms of some of the vallies, and in this peat earth the proportion of sulphuric or vitriolic acid is considerable.

The Ouse, the Ivel, and the Ouzel, are the chief rivers. The Ouse, which is navigable from Bedford, and is subject to inundations, abounds with fish, and is remarkable for the size and superior quality of its eels. The Ivel is partly navigable, produces abundance of fish, and is famous for its gudgeon. The grand junction canal stretches for about three miles along the borders of the county.

The population of Bedfordshire, which was estimated in 1801 at 63,393, had increased in 1811 to 70,213. The annual value of the land at rack-rent is stated at L.280,000 Sterling. Bedford, the capital of the county, Ampthill, Biggleswade, Dunstable, are the principal market towns. The manufactures are chiefly thread-lace making, which, it is said, has declined, and given place to straw-plaiting. A whiting manufactory is established at Dunstable.

The Duke of Bedford, the Marquis of Bute, Earls Spencer and Upper Ossory, and Lord St John, possess large estates in the county. Wheat and barley are the principal corn crops, of which a good deal is exported. The management of the dairy is an object of attention, and affords a considerable supply to the London market. Woad is raised in some places for the use of dyers; and in the sheltered vales the culture of culinary vegetables for the neighbouring towns is extensive. The splendid experiments in various departments of rural economy, and particularly in the improvement of live-stock, which have been long carried on under the auspices of the Dukes of Bedford at Woburn abbey, if they are not on too grand and too expensive a scale for general imitation, could not fail to rouse attention and to stimulate exertion in similar undertakings.

BEDFORD, the capital of the county of the same name in England, stands on the banks of the river Ouse, which is navigable for small vessels to the German ocean, is 50 miles north from London, and includes a population which, according to the estimate in 1811, was equal to 4605. Bedford is described as a neat, clean town; the public buildings, some of which have been lately erected, are commodious and elegant; and the great inn raised on the spot formerly occupied by the castle is a magnificent structure. The manufacture of thread-lace is confined to females; wool-combing is a small branch of industry; some coarse woollen stuffs are made; lime is burnt in the neighbourhood; coak is prepared for drying malt; and roof-tiles for the supply of the contiguous villages.

Bedford has numerous charitable establishments, some of which are of great antiquity. The endow-

Bedouins.

ment of Sir William Harper, a native of Bedford, and afterwards, in 1561, lord mayor of London, is not the least remarkable for the increase of the fund and the mode of its application. He purchased 13¼ acres of land for L.180, in the parish of St Andrew, Holborn, and bequeathed it to the corporation of Bedford for the support of the grammar-school, and for furnishing dowries on their marriage to young women belonging to the town. The original rent was L.40. In 1668, it rose to L.99, on a lease for 41 years; and afterwards, on a building lease for 51 years, at the annual rent of L.150. Bedford Row and the adjoining streets were raised on this property; and when the leases were renewed, the net rent was L.4000 per annum, and expected on second renewals to rise still higher. But the application of one part of this fund has not been attended with beneficial effects. The prospect of L.20 as a dowry, has been the source of rash and unfortunate marriages, and has increased the demands on the poors rates, or added to the inhabitants of the work-house.

Bedford in the early periods of English history was the scene of many severe struggles between contending factions. The strength of the castle pointed it out as a place of great importance.

BEDOUINS, tribes of wandering Arabs, who inhabit the desert regions of Arabia, and other parts of Asia and Africa. The name is derived from an Arabic word, which signifies *desert*, and *inhabitant of the desert*. The Bedouins are regarded as the purest race of the Arabians, because they have no intercourse with other nations. They have lived from the remotest ages in tents, have never associated in towns or villages, and migrate from place to place in the desert, as safety, pasturage, and water for their flocks, camels, or horses, may require. The Bedouins live under the authority of a chief or *scheik*; the different tribes are independent, and sometimes in a state of warfare with each other; but the whole, descended from the same original stock, having the same manners, and professing the same religion, are considered as the same nation; and besides, one of the scheiks is acknowledged as the supreme ruler, with the title of *emir*, or prince.

The manners and customs of the Bedouins, whether they are found in Arabia or Africa, are nearly the same, and exhibit altogether the native simplicity of the pastoral age of society. From their wandering mode of life, they are subject to numerous privations, and have thus become robbers by profession. Many of the tribes who are in the vicinity of the route of travellers and caravans that traverse the desert, live by plunder. But with all this rapacity, the virtue of hospitality to strangers is highly respected, and rigidly practised. It would be regarded as the most unpardonable offence among the Bedouins, to violate in the slightest degree the rights of hospitality, even when an opportunity is offered of avenging an injury on an enemy. See Volney's *Travels in Syria*, &c. Sonini's *Travels in Egypt*.

BEE, *Apis* of Linnæus, a numerous genus of insects. See ENTOMOLOGY.

BEE.

Introduction.

THE object of the present treatise is to give such a description of the *habits* and *manners* of the *common honey-bee*, as will afford to the readers the latest and most accurate information respecting these interesting and useful insects; to investigate the nature and explain the uses of the products which they furnish, and to notice the most approved and advantageous methods of managing them. These subjects have always been deemed important, and have attracted the attention of naturalists and writers on rural economy, from the days of Columella and Virgil to those of Huber and Huish. It is only within these few years, however, and chiefly in consequence of the researches and experiments of the latter writers, that any considerable accuracy in the natural history of bees has been attained, and there are still a few disputed points which the most able investigators of modern times have hitherto failed in their attempts to determine.

Many causes have contributed to retard the progress of scientific knowledge and practical improvement in this interesting department of rural economy. The investigations necessary to clear up disputed points are extremely difficult; and experiments require to be frequently and carefully repeated, that hasty and erroneous conclusions may not be formed. It is remarkable, that the ablest investigators into the economy of bees, especially Huber and Huish, are completely at variance in many of the most important points; which is right, we presume not to judge, but shall, in the course of our remarks, state the opinions of both, leaving it to time and future experience to decide between them. The practical improvement of managing bees has been much impeded by prejudice and superstition. The favourite doctrine, that "old ways are always best," prevents many persons from adopting what both reason and experience have proved to be easy and judicious; and the popular superstitious notion, that "bought bees never thrive," and that they must be either *begged* or *stolen*, has, in this country, rendered the culture much less general than it would otherwise have been.

In the first part of this treatise, we shall exhibit a succinct view of the *economy of bees*; and in the second shall describe the most approved methods of *managing* them.

Economy.

PART I. ECONOMY OF BEES.

Description and varieties.—The general appearance of the honey-bee is familiar to every one, but there are some parts of its structure which require to be described in order to understand the particular functions which these parts perform.

In every hive, or separate colony, there are three kinds of bees, differing from each other in size, proportions, and peculiar organs. By far the greatest number, comprehending from 20,000 to 40,000, or more, are of a comparatively small size, being about six lines long, are furnished with a sting, and with imperfect ovaries or internal female generative organs. These are the working bees; they collect honey and wax, construct the combs, feed the young, and protect the hive from the incursions of other insects. From their internal structure, it is ascertained that they are essentially female, though but few instances occur of their laying eggs. The next in point of number, to the amount of 1500 or 2000, are larger and thicker than the former, being about seven lines long, have a duller flight, are devoid of sting, and are evidently of the male sex. These are called *drones*,—they take no part in the labours of the hive, and seem to serve no other purpose than impregnating the female. Over this numerous assemblage of workers and drones presides a single female bee, of more majestic port than the rest, longer than the drones by about a line, and, though of a more slender form, very strong and active. She is justly styled the *queen*, and is the only individual that uniformly lays eggs and produces young, so that she may be called the mother of the colony. Like the workers she is provided with a sting.

The structure of the working bees particularly demands our attention, as it illustrates the operations which they perform. They are furnished with a mouth and jaws, capable of biting and tearing substances of considerable solidity, and with a *proboscis*, or trunk, fitted for taking up liquid matters, and conveying them by the mouth into a capacious double stomach. It is still disputed whether the proboscis be tubular or solid, but the latter opinion seems at present to prevail, and it is supposed to be employed rather as a tongue than a sucker. The hairs that cover the bodies of these insects are so formed as readily to collect powdery substances; and their feet are constructed like brushes, so that these matters are easily swept off the body, and lodged in cups bordered with hair, that are hollowed in the third pair of legs. The sting, whose wound proves so painful even to man, and is speedily fatal to insects, is a very complicated weapon. It consists chiefly of two opposite rows of barbs, terminating in a point at the outer extremity, and so united as to form a tapering tubular canal that communicates with a bag placed within the belly, and filled with a very acrid poisonous fluid. This sting is rather an offensive than a defensive weapon, and is used almost solely for the purpose of destroying those enemies that presume to enter the hive, or of exterminating the drones when their services are no longer needed.

Queen.—The queen is in many respects the most important personage in the hive, as on her depends the continuance of the colony, and she conducts those numerous hordes that annually quit the parent dwelling in search of new habitations. She is therefore regarded with peculiar care and affection, and is never suffered to quit the hive except to head a corps of emigrants, or to fit herself for becoming the mother of a future race. But before we detail the interesting particulars that respect the functions and manners of the queen, we must attend the labouring bees, and describe the operations which they perform.

Operations.—As soon as a colony of bees is established in a hive, they commence their labours; and from the rapidity with which these proceed from the first, it is supposed that the swarm carry with them a quantity of materials to lay the foundation of their future works. As it is of the utmost consequence that they should be defended against the injuries of the weather, and as few hives are sufficiently close in their junctures for this purpose, the first object of the bees is to procure a natural cement, capable of filling up the chinks and crannies of their dwelling, and of resisting moisture.

Propolis.—With this view they collect from certain vegetables large quantities of a resinous matter, which, though soft and ductile when first obtained, has the property of becoming hard on exposure to the air. This has been called *propolis*. It is collected chiefly from the buds of certain trees, especially those of the pine tribe and the poplar, is of a reddish brown colour, of an agreeable aromatic odour, and so glutinous, that it is with some difficulty that the bees detach it from their legs. Besides lining the junctures of the hive, this substance is employed by the bees to envelope the bodies of snails and the larger insects which they have killed, but cannot remove from the hive, as this coat of resin has the effect of preventing the putrefaction of these dead animals.

Construction of combs.—Leaving a sufficient number of their comrades to protect the queen and hive, and carry on the internal operations of the colony, the workers set out in search of provisions and materials for building. They visit flower after flower, and cull from each those substances that are to supply both their present and future wants.

Their first object after obtaining a sufficient defence against the injuries of the weather, is to construct combs in which to lay up their provisions, deposit the eggs of the queen, and rear the young brood. Without at present enquiring into the nature and origin of the wax of which the combs are formed, we shall describe their general appearance, the particular form of the cells of which they are composed, and the method employed by the bees in their construction.

The combs are suspended in a perpendicular direction from the top of the hive, and are arranged parallel to each other, with an interval of only a few lines between them. Each comb is composed of two sets of cells, opening at opposite surfaces of the comb. The general figure of the perfect cells is that of a hexagonal prism, opening at the surface by its base, and separated from the opposite cells by a pyramidal cavity called its bottom. The opposite cells are so arranged, that the planes which form the terminating pyramid of one cell, concur to form the bottoms of three others of the opposite cells, so that they are not placed point to point. The cells which form the highest series of the comb have a different form from those that make up the body of the comb, for as two of the sides of the hexagon are cut off by the plane to which the comb is attached, the openings of these upper cells are irregularly five-sided. The edges of the comb are composed of small irregular cells, but to these there are generally attached distinct oblong structures, composed of large cells, for the reception of those eggs that are destined to produce queens, and are therefore called royal cells.

In forming the cells, the working bees detach with their hinder feet the plates of wax, which are prepared in a manner to be presently explained, from the rings of their belly, and carry them to their mouth, where the wax is worked till it become soft and ductile. Thus prepared, it is applied to the part from which the comb is to be suspended, or that to which an addition is to be made, where it is formed into a block of a lenticular shape, thickest at the top. The interior of each cell is formed by the bees scooping out the wax from this solid block, till its sides are sufficiently thin, an operation which requires the successive labours of many bees to accomplish. The pyramidal part of each cell is first formed, and then the sides are constructed of the wax that had been scooped out, or by the addition of fresh plates.

Several attempts have been made to explain the peculiarities of figure just described in the cells of the honey-comb, but none of them is altogether satisfactory. Buffon attributed the hexagonal form to the necessary and equal pressure of a number of bees occupied at the same time in contiguous cells, which he supposes at first to have been cylindrical, and to have assumed the shape of hexagonal prisms in consequence of this equal pressure. This hypothesis appears ingenious, but by no means accounts for the inequality in the size of the cells, for the pyramidal form of their central extremities, and for the nicety with which these extremities are adjusted on opposite sides of the comb. It is found, that though the natural direction in which the bees work is downwards, they can be made to build from below upwards, and in either way it appears that from the first completion of each cell it is of a prismatic form.

The cells of a comb when first constructed are soft and white, and their edges thin and sharp. By degrees they become harder, assume a yellow tinge and a glossy surface, and their outer edges become thicker and stronger. This is found to be owing to a coating of resinous varnish, similar to the propolis already mentioned.

Collection of honey.—The combs being thus prepared, the working bees proceed to deposit in them the provisions collected for the use of the colony, and the queen, when impregnated, begins to lay her eggs. The provisions of bees consist partly of honey and partly of pollen or farina. The honey they collect from the nectaries of flowers, licking it up with their proboscis, and conveying it by the mouth into the stomach. In its general properties, honey, when first collected, resembles a solution of sugar in water, with the addition of a little mucilage, but modified in taste, smell, and colour, by the nature of the plant from which it is collected. It evidently undergoes some change in the stomach of the bee, though in what this change consists is not distinctly ascertained. When the bees return to the hive, they deposit in cells the honey they have collected, by an action resembling vomiting, or deliver it over to the internal workers, who deposit it in the cells intended for its reception, and when these are full they are sealed up with a plate of wax.

It appears that the bees are not very nice in the quality of the saccharine juice which they collect. Their chief object seems to be abundance; and they are known to lay up a store of honey which, though probably affording an innocent nutriment to them, proves deleterious when taken into the human stomach.

Origin of wax.—It was long disputed what was the nature and origin of the wax that forms such an abundant product of a bee-hive. Most naturalists supposed it to be derived from the pollen, which was conceived by some to be taken into the stomach of the bee, and there fitted by digestion for the formation of wax. M. Duchet, previous to 1778, hazarded the opinion, that it was formed from honey; and Wildman actually saw plates of wax at the bottom of a hive, appearing as if moulded by the bodies of the bees. These scales were observed by John Hunter in actual contact with the bodies of these insects; but it was reserved for Huber to put this matter beyond a doubt, by his observations and experiments.

He has, we think, nearly proved that wax is a secretion formed within peculiar cavities, of a pentagonal shape, that are situated on each side of the middle process of the abdominal scales in the belly of the working bees, and that it may be seen exuding in a fluid state on puncturing these cavities. It is secreted chiefly by a distinct set of bees, who are provided with a more capacious stomach than the other workers, and consume a greater quantity of honey. It is this honey that constitutes the source from which the wax is produced; and it appears that the saccharine principle of the honey is the essential part, as even a greater quantity of honey is formed by those bees who are fed on sugar and water, than by such as live on honey. These facts were experimentally ascertained by Huber, and have been verified by frequent observation. We are aware that Mr Huish ridicules this opinion of Huber and his followers, and asserts, that, according to the old notion, honey is formed from pollen taken into their second stomach, and there elaborated with water or honey; but it is long since we have been convinced that ridicule is not the test of truth; and we think that, in more instances than one, Mr Huish has substituted this seducing talent in the place of sound argument or logical induction.

Pollen.—A third substance collected by bees is *pollen*, or the *farina*, contained in the anthers of flowers. This is a powdery resinous matter, composed of minute globular particles, capable of coalescing into a coherent mass. The bees collect it by means of the brushes attached to their feet, and the hairs that cover their body, combining a number of particles into a pellet, which they deposit in the basket-shaped cavity in the middle of the hinder legs. This pollen is laid up in appropriate cells, and being destined for feeding the young brood, has very properly been termed *bee-bread*. A surprising quantity is collected for this purpose, a pound having been known to be carried into a hive in one day. It is curious that the cells are never filled with pollen, but this matter is covered up with honey.

The labours of bees in collecting these materials depends much on the state of the weather. When the sky is calm and serene they work with activity and dispatch, but in wet weather they confine their labours chiefly to the internal operations of the hive. It has been remarked that they are peculiarly diligent in a thunderous state of the atmosphere, probably foreseeing that such a state will terminate in rain.

Impregnation, &c. of the queen.—When a sufficient number of cells have been constructed, and provision made for the future brood, the queen begins to prepare herself for the exercise of the important function of increasing the population of the hive. With this view, as we are informed by Huber, she seizes the opportunity of a fine day to sally from the hive, and seek, during her aerial excursion, the embraces of the male, and among the numerous drones that fly about at these times she soon gains her object, and returns in a state of impregnation. This opinion of Huber, which is said to have been verified by other naturalists, is combated with much pleasantry by Mr Huish, though we think he has not successfully disproved it, and has certainly given no more satisfactory hypothesis of his own. He roundly asserts, that the queen remains a virgin though she lays prolific eggs, an anomaly in nature which we deem at least equal to some of those opinions which he treats with so much ridicule. He contends, indeed, that the eggs are fecundated by the drones after being deposited in cells by the queen; but how this is effected he does not inform us. Within a few days after having become a perfect insect, the queen is capable of becoming a mother; and it is even necessary, for the proper exercise of this function, that her impregnation should take place within twenty days after she has left the royal cell.

Within about forty hours after impregnation the queen begins to lay her eggs in those combs that are in the middle of the hive, and continues this process for many months, laying sometimes 200 eggs daily. She first lays those of workers and afterwards those of males. She appears conscious what kind of eggs she is about to lay, and carefully examines the diameter of the cells in which she is to deposit them, taking care that she does not introduce them into cavities too small for their perfect developement.

The eggs destined to produce future royal issue are among the last deposited by the queen in royal cells, provided for that purpose. A curious and hitherto unaccountable circumstance has been ascertained respecting this function of the queen. If her impregnation has by any means been retarded for above twenty days, she lays eggs from which only drones are produced. It is found that the laying of her eggs is obstructed by cold, and she generally gives over laying in the autumn, but begins again in the spring.

Developement.—The eggs laid by the queen bee are of an oblong oval form, and a bluish white colour. In the course of three days from their deposition, the larva or worm is hatched. It is curious that the eggs of all the three varieties are hatched in the same period, but the progress of the larva is different in each. The worm of the working bees continues in that state for five days, then occupies about thirty-six hours in spinning its cocoon, in which in three days it becomes a nymph, and in twenty days from the deposition of the egg comes forth a perfect bee. Drones attain the perfect state in twenty-four days, but the queen-bee escapes perfect from the cocoon in sixteen days. During this time the larvæ are carefully supplied with food formed of pollen, made into a jelly, probably by being mixed with honey, for about six days, when they cease to eat, and are shut up within their cells, though still carefully watched by the working bees. When the perfect insect is set free, the cell in which it had been confined is cleaned out and converted to other uses.

Manners of the queens.—Particular care is bestowed by the workers on the larvæ of future queens. They are fed with a richer and more stimulating jelly, and supplied with it in greater quantity than the ordinary worms. Thus the developement of the royal larvæ is accelerated. It commonly happens that two or more queens are hatched about the same time, in which case they become rivals, and the weaker fall victims to the one which is most powerful. Huber has minutely described the combats of these rival queens, which exhibit an extraordinary combination of ferocity and caution. They rush together with great fury, and take such a position with their bellies opposite each other that they might easily be mutually wounded by their stings; but as in this case both would fall, it seems provided by nature that when they feel themselves in this position they should separate. The surrounding workers, however, stimulate the rivals to a new combat, and the stronger seizing a favourable opportunity, suddenly darts her sting into the belly of her adversary, and inflicts a mortal wound,—thus displaying in this Lilliputian monarchy the same jealousy that is observed in some despotic eastern empires, admitting no sister near the throne.

The old queen entertains a similar jealousy towards the future royal race, though her own offspring. About the time when the young queens have nearly acquired their perfect state she frequently visits the royal cells, and would inevitably destroy the young queens there secluded, were she not prevented by the workers. In the early part of the season, before a colony has left the hive, the bees, aware of the necessity of preserving a sovereign for the future exigencies of the state, are particularly careful to guard the approaching young queens from the attacks of their elder rival, and accordingly surround the entrance to the royal cells with a strong intrenchment of wax, and keep constant watch to prevent the hostile attacks of the reigning queen. But when the season of swarming is past, and any farther production of queens may tend only to disturb the peace of the hive, they seem rather to encourage and assist the reigning queen in the work of exterminating her rivals.

The presence of a queen is essentially necessary to the welfare and tranquillity of the hive. Wherever she goes she is accompanied by a numerous retinue of her subjects, who throng around her and attend her with anxious solicitude. Taking advantage of this attachment of the bees for their queen, several persons have displayed feats in the management of these insects which have been beheld with astonishment. The celebrated Wildman once presented himself before the Royal Society with several swarms of bees upon his person. One hung pendulous from his chin like a large and bushy beard, another enveloped each arm, and a fourth surrounded his body. He had acquired so much dexterity in handling the queens, that it was easy for him to seize and confine them wherever he pleased, and the bees attached to each queen following their leader formed these remarkable groups.

If the presence of the queen be productive of these exhilarating effects on the community, it is not surprising that her loss should produce effects of a very opposite nature. When by any accident the bees find themselves without a sovereign, a loss which it appears they do not immediately perceive, the hive for a time becomes a scene of disorder and despair. Abandoning the care of the young brood, the bees run about in the greatest agitation, examining every part of the combs, and rushing impetuously out of the hive in search of their lost queen. This state of agitation continues only for a few hours; for when they find the queen irrecoverable, they, by a wonderful instinct, contrive a method of repairing the loss by transplanting select larvæ of working bees to newly constructed royal cells, where they feed them with the same kind of stimulating jelly with which the legitimate royal brood is usually nourished, till by this care and diligence they, in fact, convert into real queens those worms which, under ordinary circumstances, would have produced only workers.

Hence is derived an important conclusion in the natural history of the bee, that both queens and workers originate from eggs of the same kind, and become either the one or the other, according to the care bestowed on them, and the food by which they are nourished.

Swarming.—Pretty early in the season, generally in May or June, when the old queen has deposited a sufficient number of eggs to supply the parent hive with future inhabitants, she prepares, with a numerous train of followers, to quit the settlement in search of a new habitation. This emigration constitutes what is called *swarming*, and the colony is termed a *swarm*. Satisfactory reasons have not been assigned for this occurrence; for though it generally takes place when the hive is crowded with inhabitants, or is likely to be overstocked by the future progeny, it not unfrequently happens when there is abundant room. Swarming seems to depend chiefly on the queen; and it is found that just before leading out the swarm she is in a state of great agitation. The usual signs of a swarm being about to leave the hive are the following: For several days many of the bees cluster round the mouth of the hive, and, especially in the evening, hang in groups from the front of the board on which it is placed; an unusual and agreeable humming noise is perceived in the evening before the swarm issues forth; and, on the day of swarming, fewer bees are seen to issue from the hive, or enter with their usual load. To these signs may be added the appearance of a great number of drones, and an uncommon stillness suddenly succeeding very great agitation within the hive. When every thing is prepared the bees crowd to the entrance, and the queen first escaping, is speedily followed by her attendants, consisting of both drones and workers in the usual proportion. The swarm first takes but a short flight, and then rests on some bush or tree in the neighbourhood of the parent settlement, the queen alighting first and the other bees clustering round her. If not now arrested they soon prepare for a longer and more distant excursion, till they find a situation suited to their purpose of establishing a new colony, which in their natural state is generally the hollow of a tree, or within the roof of some secluded building.

It appears from the observations of Mr Knight, that scouts are sometimes detached from a hive several days before swarming, in order to seek for a situation adapted to the reception of the new colony, though in these cases no works are constructed by these purveyors. Generally more than one swarm issues from the same hive during the season, and if the summer has been very favourable three swarms have been known to proceed from one hive. In this last case, however, the parent settlement is so much weakened that its inhabitants seldom survive the winter. The first swarm is always led forth by the old queen, and the succeeding swarms by the eldest of the young queens in succession.

Extermination of drones.—A few drones accompany each swarm, probably for the purpose of impregnating the queens; but when all the swarms have left the hive, and the remaining workers in the old settlement have nearly finished the labours of the summer, and are looking forward to their winter retirement, they prepare to rid themselves of this unnecessary, and now unwelcome part of their population. About the commencement of autumn, sometimes as early as the end of July or beginning of August, they begin their work of extermination. Great bustle and much agitation prevail throughout the hive. The unfortunate males, driven from the combs on which they generally hang in careless indolence, are pursued with implacable resentment to the bottom of the hive, where they fall in one general massacre, transfixed by the stings of their former associates, and their dead bodies are thrown out upon the ground. So complete is this extermination, that if there remain any larvæ or nymphs of drones within the cells, they are dragged from their asylum and involved in the common destruction. Only in one instance are the drones suffered to remain in a hive through the winter, namely, when the settlement has lost its queen, and there appears no probability of a new one being produced before the ensuing spring.

Mr Huish contends, that the drones are not killed by the sting of the workers, as is generally supposed, but rather by their mouths biting them near the root of their wings. His great objection to the commonly received notion is, that when a bee stings a person it leaves its sting behind it and dies. Now, it by no means follows that this is the case in other instances; and indeed, were it so, of what use is the sting to these insects if the employment of it were universally to prove fatal? He also objects, that the venom of a bee is not likely to prove mortal to another bee; Why not? Does not the venom of a rattlesnake, or a Cobra de capello, prove mortal to the animal itself, when made to wound itself?

Preparations for winter.—When the scarcity of flowers warns the bees that they must expect no further supply of honey, they adopt the greatest economy to spare their winter store. Besides the honey which they still occasionally procure for persent subsistence, they collect the sweet excrementitious juice deposited by the insects called *Aphides*, on the leaves of certain plants, or exuding from their upper surface, and known by the name of *honey-dew*. They also frequently commit depredations on neighbouring hives, and on these occasions such formidable conflicts sometimes take place as materially to weaken both the invaders, and those who stand on the defensive. As winter approaches the bees consume but little of their provisions, but pass much of the cold weather in a torpid state, roused however occasionally by the penetrating influence of a mid-day sun. During the coldest weather they appear to sink entirely into torpidity.

Ventilation.—Several particulars in the economy of bees, are more properly connected with the physiology of insects. But here it ought to be remarked, that, like all other animals, bees require continual supplies of fresh atmospheric air to preserve their healthy existence. As the hive is generally very close, admitting air only by a single opening, the bees fall on a contrivance to promote the circulation of air through their habitation. To effect this purpose several of them place themselves near the entrance, and, by a constant and rapid motion of their wings, agitate the air, and this agitation is propagated by other individuals, placed at proper distances within the hive. Thus, a free ventilation is produced, and the temperature of the hive is preserved equal and moderate. During their winter torpidity, the necessity for such a constant supply of air is diminished, and they appear not to suffer by the stagnant atmosphere of the hive.

Enemies and diseases.—Bees are exposed to the attacks and depredations of numerous enemies; but we shall notice only those which are found in this country. Among quadrupeds the badger sometimes overturns the hives, and robs them of their contents, unawed by their stings, which are not able to pierce his thick and shaggy hide; and field mice occasionally force an entrance, especially while the bees are in a torpid state. Among birds, the bee-eater, the shrike, the swallow, the sparrow, the tit-mouse, the cuckoo, and most poultry, greedily devour them, and the wood-pecker is said sometimes to succeed in breaking through the hive, and thus attacking its inhabitants. Of reptiles, lizards and toads watch for and seize them when they alight near their retreats; but their most formidable enemies are among the insect tribes, especially the wasp, the hornet, the ant, the larger species of spiders, and the moths. This last is the most insidious, but not the least destructive of their enemies, as it insinuates itself into the hive, and deposits its eggs among the combs, where the larvæ when developed make terrible havoc, and frequently compel the bees to quit their hive. A very large species, the *sphinx atropos*, or death's-head moth, is, in some countries, particularly destructive, and is supposed to prevent the bees from exerting themselves in their own defence, by a peculiar shrill sound which it emits, and which is said to resemble that sometimes uttered by the queen bee. We believe this moth is not common in Britain; but on the continent it sometimes deprives the farmers of their whole stock of bees. To protect themselves against these intruders, the bees contrive, towards winter, to straiten the entrance into the hive, by raising a narrow passage of wax and propolis capable of admitting only one or two of their number at a time.

Bees are subject to three principal diseases, namely, *dysentery*, distinguished by the black colour and offensive odour of their excrement, and supposed to be contagious; a nervous affection, called by some writers *vertigo*, supposed to be produced by the honey of some narcotic plant; and a kind of *debility*, shewing itself by a degree of langour, and a swelling and yellow colour of the head and tips of the antennæ. The two former of these diseases are supposed to be incurable; but the last is said to be removed by giving the bees Spanish wine.

Duration of life.—Bees so seldom die a natural death, that it is not easy to determine the period of their existence. Most writers however agree, that it seldom exceeds two years among the workers, though the term of life assigned to the queen is somewhat longer.

Part II. Management of Bees.

The cultivation of bees is extremely profitable, and merits much more attention than it generally receives. It is still capable of much improvement, though the labours of modern observers and cultivators have afforded many valuable hints. There are two great objects which the proprietor should keep in view—to enable his bees to collect as much wax and honey as possible, and to encourage their propagation and increase. To attain these objects he must attend to the *situation* of the *apiary*;—the *structure* of the *hives*;—the *management* of *swarms*;—the the mode of *removing the combs*;—and the *protection* of the bees during winter.

Apiary.—The best situation for bee-hives is a garden, well stocked with flowers and flowering shrubs, or low standard fruit trees, and in the neighbourhood of pastures bordered with heath, furze (whin,) or broom. The contiguity of high trees should be avoided; but it is very desirable that a small rivulet or stream of water should be near, as bees are fond of sipping water, even though it be muddy. The hives should be arranged along a border, a few feet from a wall not too high, that has a moderately warm exposure, somewhat between south and east; and they should be placed separately, each on a stout wooden table, with a narrow projecting part in front, supported on a strong wooden post, about two feet from the ground. Thus placed, the hives are sheltered from inclement blasts, while they are not too much exposed to the heat of the sun reflected from the wall, and being thus elevated on a single support, are not so liable to the incursions of large crawling or climbing enemies. The table should be rather larger than the bottom of the hive, and should be a little raised in the middle to allow the rain to run off. There must be a sufficient space between the hives, to prevent disputes among the neighbouring settlements; and for this purpose an interval of at least three or four feet is requisite. No tall plants or rank weeds should be suffered to grow round the hives, as they encourage and harbour insects; but the ground below the tables should be spread with gravel, or sprinkled with coal ashes. The table on which the hives are placed should be swept clean three or four times a-year, especially in the beginning of spring and conclusion of the honey season.

It is of some consequence to select for the garden such flowers as are most productive of wholesome honey, and to keep up a succession of these from spring to autumn. Among the most profitable summer plants mignionette holds a high rank, and many of the pot herbs, as thyme and marjoram, are much frequented by the bees.

Transporting bees.—In some countries, particularly Egypt and Asia Minor, the proprietors of bees transport their hives from one place to another, for the sake of providing them a more abundant supply of flowers. The practice has been followed to a certain extent in France, and even in Britain; but it is not probable that in this country it will ever become general or sufficiently advantageous to compensate the trouble and expense attending it. In conveying the hives from one situation to another, it is proper to tie each separately in a cloth or sheet, and arrange them on hand-barrows, or in a well hung spring-cart, or what is still better, where water-carriage is admissible, in a boat; travelling by night, and resting by day, to let the bees feed, till they reach their place of destination. Great care should be taken not to agitate the hives, for fear of loosening and separating the combs.

Structure of hives.—The hives in which bees are kept, may be made either of straw or wood. The former are warmer, the latter more convenient, especially for the purpose of observation. The common bee-hive, or *scape* as it is sometimes called, is nearly of a spherical figure, with a segment cut off below, or sometimes like a bell; and though well suited to retain the combs, is very ill adapted to the economical purpose of abstracting them without destroying the bees. A much better form is that of a cylinder, about nine inches deep, and twelve in diameter, open at both ends, but having a circular frame, with as many cross bars of wood as there are intended to be combs in the head, to close it in at the top. These hives are so constructed as to fit over each other, so as to increase the internal cavity, and the uppermost is covered with a hemispherical lid nicely adjusted, fastened with packthread, and the junctions secured with putty or mortar. Two of these cylinders adapted to each other, and the entrance hole of the upper closed, form a very proper habitation for a new swarm, and the lower cylinder, when full, may be exchanged for an empty one, in the mode to be presently described.

We have seen eight-sided wooden boxes, having several slits at top capable of being closed by a sliding board, and a pane of glass, with a sliding shutter in one side, for the purpose of observing the bees at work, employed as hives; and if not made too large they answer very well.

But of all the wooden hives of which we have seen any account, we prefer that contrived by M. Huber, and described by him in his "New Observations on Bees." This is called the *leaf* or *book-hive*, from its being composed of thin compartments fitted laterally to each other, and opening in the manner of the leaves of a book. The component *leaves* of this hive form each a frame of wood twelve inches long by ten broad, and about one inch thick by fifteen lines from side to side. Those intended to form the interior of the hive are open at the sides, but the two that are to form the outer lateral parts are closed by a stout board. They must all be nicely adapted to each other, and fastened together by hinges screwed to the edge, so as easily to be removed or replaced. Each compartment is intended for holding one comb, and Huber recommends placing a small piece of comb at the upper bar to direct the operation of the bees. Each has a moderate-sized hole in the front edge near the bottom, for the passage of the bees in and out. It is convenient to have them so adapted that the whole may open in the middle for the purpose of introducing a swarm, or examining the interior of the settlement. By the addition or removal of such divisions, the size of the hive may be regulated according to circumstances. The combined panes are covered at the top with a sloping wooden roof to throw off the rain; and they are kept firmly together by outside bars secured by pins.

The description here given of Huber's hive differs in some respects from that given by Mr Huish; and it appears that there are at least two modifications of it, though the general principle of construction is the same.

These hives are attended with many advantages. In particular they admit of inspection into every part, for the purpose either of curious observation, or of ascertaining the state of the colony, or the situation of the queen; they tend to increase the quantity of wax and honey produced, and they allow the greatest facility in removing any part of the combs without destroying, or materially disturbing the bees. The only inconvenience to which they seem liable, is, that they are apt to expose the combs and bees to injuries from the weather; an objection which may be obviated by making them of well-seasoned wood, and taking care that the junctures are extremely close.

The hive recommended by Huish, which is nearly the same with the Greek hives described by travellers to mount Hymettus, of which it is not easy to conceive that the author was ignorant, is of straw, shaped like a flower-pot, and made open at both ends. The smaller end forms its bottom; and upon the other are laid, at equal distances, eight or nine long pieces of wood, about three inches broad and half an inch thick, and secured on the edge so as to be easily lifted, but not to slide backwards and forwards. Over these cross bars is laid a piece of network; over this a circular board, having six holes

Management.

above the insterstices of the bars, fitted with perforated tin-plates, to let out the heated steam of the hive; and the whole is covered with a convex straw top, hanging a little over the edge, and firmly cemented to the body of the hive. The combs being attached to the cross bars, are, from the shape of the hive, easily lifted out, and fresh bars placed for the bees to construct new combs; so that this hive has the advantage both of simplicity of construction and facility of management.

Sometimes several hives are placed above each other like the stories of a house, constituting what is called the *storyfying system.* This system is by some supposed to have many advantages; as that the bees have most room, and have therefore not so much inducement to swarm; and that being more numerous, they preserve a higher temperature in the hive and breed earlier; while, from the quantity of combs, they are not exposed to famine. We consider some of these advantages as imaginary, and advise this system not to be carried too far.

Management of swarms.—When it is expected that a hive will swarm, strict attention must be paid to watch the exit of the bees and prevent their escape. Swarming takes place in the early part of the day, and in fair weather, so that the trouble of watching is comparatively small. When the swarm has fairly collected, and alighted for its first rest, preparations should immediately be made for securing the bees before they take their second flight. For this purpose, a clean hive is to be provided; and if it be made of straw, two cross pieces of wood should be placed within it, about the middle, so as to assist in supporting the combs. It is usual in this country to wash the inside of the hive with sugar and water, and rub it well with green leaves, or a brush to rub off the loose ends of straw that project from the sides. Taking the hive, thus prepared, in one hand, and being defended by coarse worsted gloves, gaiters on his legs, and a linen dress, with a mask of wire-cloth over the hat and face, and tied round the body, the person who is to *hive the swarm*, as it is called, holds the hive immediately below the assembled group of bees, and giving the bough or bush on which they have settled, a smart shake generally succeeds in lodging most of them within the hive. He then cautiously turns down the hive upon a board or table, covered with a cloth, and leaves it in the same spot till towards the evening, when it is carried to the place where it is to stand. It is sometimes necessary to detach the bees, by means of a goose's wing, which forms the best brush on these occasions; and in all cases where the queen can be found, and secured within the hive, the bees are easily lodged in their proper habitation.

There are certain precautions to be observed by those who undertake the hiving of bees, or indeed any operation in which the bees are likely to be irritated. He should be dressed in light-coloured clothes, should avoid breathing on the bees, and should there arise great agitation, and the bees appear much irritated, it will be proper to keep them off by the smoke of burnt linen, paper, or dry cow-dung, thrown on live coals in a small chaffer or pan, with a perforated cover and a short handle, which the operator is to carry about with him.

It is of some consequence, especially in the later swarms, to ascertain the size of the swarm, that it may not prove too weak for surviving the winter. The usual method of doing this is by weighing the hive. If the weight of the bees, exclusive of that of the hive, do not amount to 4lbs. avoirdupois, it is considered as a weak swarm; and in this case it is recommended to put two swarms together. To do this, so as to secure the tranquillity of the bees, it is necessary to take away the queen belonging to one of the swarms.

Artificial swarms.—It is not a difficult matter, and may sometimes be desirable, to separate the bees in a hive into distinct colonies, without waiting for their swarming. This is called producing artificial swarms; and is easily effected by means of Huber's leaf-hive, in the following manner. The usual compound hive, formed of ten or twelve compartments, is cautiously divided in the middle, and two leaves, each closed on one side, are gently slid between the two halves, so that their open parts shall be next the interior of each half. Search must now be made to find which half contains the queen, and should she be found in that which has most eggs or worms, it will be necessary to transfer her to the other half, in order to give the bees in the former division the best chance of rearing a new queen from the brood there lodged. Then the two half hives are to be brought together, and united, by tying a small cord firmly round them, taking care to place them in the same position as the whole hive had formerly occupied. The former opening in front of the hive is to be closed, and another opened in each of the divisions, as far as possible from each other, only that it would be better to keep the division that is without a queen so far closed as not to allow the bees to pass while it admits a supply of fresh air. The bees soon repair the loss of their queen, and in about ten or fifteen days the hive may be finally separated.

We have heard of an ingenious way of compelling bees to swarm, when they appear rather tardy in doing so. This consists in removing the hive, which has shewn the usual indications of swarming to another part of the garden; and we are assured that in a short time the swarm has issued forth, and alighted on the table that supported the old hive, so that it was easily collected in a fresh hive and transferred to a separate stand, while the parent settlement was brought back to its original seat.

Abstraction of combs.—It is well known that the usual method of taking possession of the spoils collected by the bees, is to place the hive over a hole dug in the earth, introducing below it lighted brimstone, and closing the mouth of the hive so as to suffocate the unfortunate insects. This is not only cruel, but it is very impolitic and extravagant, and it tends to injure the flavour of the honey. With the common spherical hives it is indeed not easy to remove the combs in any other way, but it may be done with the cylindrical straw-hives already described, and still more easily by employing the leaf-hives of Huber. The best time for taking the combs is when the hives have attained their greatest weight;

Management.

to ascertain which, they should in autumn be frequently inspected, and raised so as to be weighed by hand. The heaviest hives, and those containing the freshest combs, are to be selected; and when the straw-cylinders are employed, the bees are to be driven towards the upper division, by tapping gently for sometime upon the lower, after loosening any cement by which the junction had been secured. Then a long and pretty sharp knife, or what is better, a clean wire, with two handles, is to be passed between the lower division and that immediately above it. The former is then to be removed to a distance; and if the season be not too far advanced, or if the bees appear to require room, an empty hive is placed below and the juncture secured as before. If the upper compartment be of small size, it will be proper to place an *eek*, or shallow cylinder, below; as, when the combs are cut close to the bottom, and consequently rest upon the table, if no addition be made, the circulation of air through the hive is materially obstructed, and the bees often perish before they can open proper communications between the combs. It is necessary, therefore, when no *eck* is added, to cut out a portion from the lower part of each comb to ensure communication and ventilation. With the hive of Huber all that is necessary is to select those divisions which contain the richest combs, and cautiously separate them from the rest, substituting empty ones in their room; and this may be done at any part of the season. If the combs abstracted contain many cells filled with young bees, these portions may be cut out and fastened within the empty divisions.

In taking away the honey and wax without destroying the bees, it is proper to leave at least what may be necessary to support them through the winter, unless it be so early in the season that they have time to collect a fresh stock. The quantity of honey and wax that a hive of bees can collect during one season varies considerably, according to their numbers and the abundance of flowers near them. An ordinary hive will yield from 50 to 80 pounds of honey, and two or three of wax; but when the bees are allowed sufficient space, and the season productive, more than double these quantities has been produced.

Separation of the honey.—More nicety is required in the separation of the honey, and management of the wax, than is commonly supposed. The combs should first be carefully examined; the young brood, bee-bread, and any decayed or much discoloured parts cut away, and the comb containing honey sorted according to its quality. Then, with a sharp knife, the coat of wax that closes the cells is to be pared off, the comb cut in pieces, and laid on coarse haircloth sieves to drain. The honey procured in this way, without heat or pressure, is the purest, and is called *Virgin honey*, and should be kept by itself. Gentle pressure, assisted, if necessary, by moderate heat, procures other honey, which is generally mixed with a little wax. From this and other impurities it may be freed, by melting it in a vessel placed in a pan of boiling water, scumming off what rises to the surface, and pouring off the clear melted honey from the sediment.

When all the honey has been separated, the wax is to be melted with water, and strained through a cloth sufficiently coarse to admit the wax to pass through without the impurities with which it is contaminated. It is then left to cool on the surface of the water, again melted by itself with a gentle heat, and poured into proper dishes to cool into those thick round cakes in which it is usually bought.

Uses of honey and wax.—Besides being very generally employed as an article of diet, honey is much used in medicine, in making those acid syrups called oxymels, and as a grateful and laxative emollient; though, from its often exciting griping pains in the stomach and bowels, its use has of late been much superseded by that of sugar. It is a common external application among country people, in cases of burns and inflammation of the eyes, in which it has the valuable property of *doing no harm*. From this substance, too, is prepared that fermented liquor called *mead* or *metheglin*.

Wax is a still more valuable article than honey, but is produced in much less abundance. So little equal is the produce of wax in this country to its consumption, that it is asserted by Huish that nearly L.80,000 is annually paid by Britain for wax imported from abroad. Most of this large quantity comes from Germany, and is collected and shipped chiefly at the port of Dantzic. Much wax is used in the practice of surgery, as it forms a principal ingredient in most ointments, cerates, and plasters; but the greatest consumption of this product is in the manufacture of candles, for which purpose it is previously bleached. Wax is now very commonly employed, melted and mixed with oil of turpentine, for giving a polish to mahogany furniture. The best wax is of a light yellow colour, a fragrant smell, and rather brittle than soft. When melted it should be transparent, and deposit very little sediment.

Preservation of bees.—The preservation of bees through the winter, and the protection of them from the various enemies and casualties to which they are exposed, form an important part of their management. When the state of the hives has been properly examined at the end of autumn, and such portions of the honey and wax have been taken away as it is thought the bees can spare, the space between the lower edge of the hive and the table on which it stands should be filled up with fine mortar, and the mouth of the hive should be contracted so as to admit only one bee at a time to pass. It is also proper to furnish the hives with a covering capable of defending them from rain and snow. The usual covering employed for this purpose is a conical head of straw, in which the straws are arranged longitudinally in the way of a thatch, and not too tightly bound together. This throws off the wet extremely well, but it is apt to encourage the attacks of mice and reptiles, who nestle in the straw. It would, perhaps, be better to make the covering of wood, well painted or pitched.

It is no uncommon error to suppose that bees cannot be kept too warm in winter, and many persons cover them up very closely. This, by preventing the natural torpidity of the bees, tends to waste their provisions; and it is now well ascertained, that bees survive the winter in the woods of Siberia, and even when placed in an ice-house.

Feeding of bees.—It is sometimes necessary, when the honey season has been bad, or when too much of the combs has been abstracted from the hive, to feed the bees during a considerable part of winter. They may be fed upon syrup, formed by dissolving a pound of honey, or three-fourths of a pound of sugar, in a quart bottle of good ale, boiling it to a proper consistence. The best method of introducing this into the hives, is by means of joints of what is called sheeps-parsley, or kekses, formed into troughs by cutting away a part of one side between the joints. One of these filled with syrup will generally suffice the bees of a hive for one day. These troughs should be introduced full in the evening, and removed next morning.

The feeding of bees should be begun sometimes before an absolute scarcity takes place in those hives which are known to be too weak to stand the winter; and it is often necessary to have recourse to this expedient in the early part of spring, when the weather is cold and moist.

Preventing depredations.—The preventing of the depredations committed by the various enemies of bees, and counteracting their attacks, require different precautions for almost each species of enemy. We shall here adopt Mr Huish's arrangement, in considering man as their principal enemy, and notice the method he proposes for preserving hives from being stolen. This consists in perforating the post on which the table is placed with a hole sufficiently large to admit a pretty stout chain that passes from an iron hoop passed round the body of the hive, and joined to an iron arch that goes over the top, and securing the chain below by a good padlock. The attacks of field-mice are best prevented by setting traps at some distance from the hive to catch and kill these animals. Huish's trap is simple and ingenious. A thread is passed through a pea soaked in water, and fastened at each extremity to a stick fixed firmly in the ground, and a brick is made to rest in an inclining position on that part of the thread that holds the pea. The mouse coming to devour the pea, bites the thread in two, and is crushed by the falling brick. Perhaps the only method of preventing the attack of birds, is to watch them, and shoot a few, as examples to the rest; or feathers attached to a cord, and fastened to posts, may be placed near the hives, as practised by gardeners, to frighten away the birds from their crops of seed. Lizards and toads should be destroyed wherever seen, and may be prevented from entering the hive by contracting its mouth. It is not easy to prevent the depredations of wasps and ants; and, perhaps, the only certain way is to search for and destroy their nests. The practice of hanging bottles of sweetened water near the hives is absurd, as it attracts insects, and, when near the hive, they will rather enter it, as they prefer honey to sugar. To prevent spiders from constructing their webs within the hive, it is necessary to examine the hive pretty frequently before the depth of winter, and clear away any cobwebs that may have made their appearance. No certain remedy, as far as we know, has been proposed for preventing the ravages of moths that have once entered a hive. These insects always attack the weakest hives; and all that can be done is to transfer the bees into another hive provided with healthy combs.

By way of concluding this part of our subject, we shall give an abstract of what Mr Huish calls the "*Apiarian's Monthly Manual,*" noticing, in a general way, the circumstances to be attended to under each month, beginning with

October.—Examine and weigh the hives; and after cleaning the stools, fasten them down for the winter. See that the coverings are clean and weatherproof; and for the last time remove what combs can be spared.

November.—Inspect the hives, and clean the stools, contract the entrance, and see that the coverings are clean, and the hives so secured as not to be blown off by the wind.

December.—In very cold or snowy weather close the mouths of the hives as much as possible, and clear away any snow that falls upon the table.

January.—Towards the latter end, give the bees more air.

February.—Enlarge the entrance of the hive, and in mild weather inspect the hive and clean the stools. This is a good time for purchasing hives.

March.—Remove all encumbrances from the mouth of the hive, and make every part thoroughly clean. Supply the bees with fresh water. Make an addition to such hives as are strong and heavy, and extract such combs as are old and discoloured. Feed weak hives.

April.—Destroy moths and butterflies. Watch for the signs of swarming; and towards the latter end make artificial swarms, where desireable. Destroy wasps, especially the queens.

May.—Frequently inspect the hives, and clean away every thing offensive. Make preparations for hiving swarms, and keep a good look-out in fine weather.

June.—Feed new swarms in rainy weather, and enlarge such hives as are numerous and active.

July.—Remove part of the produce of the bees. Destroy wasps nests, and inspect the hives for vermin.

August.—Examine and weigh the hives, and take combs from such as exceed 30lbs.

September.—Transport hives to more abundant pastures. Assist in killing drones. Furnish new coverings where necessary. Inspect the hives, clean the stools, and destroy vermin.

It will be readily conceived that these directions do not equally apply to every part of Britain; and in general we may remark, that as the climate in the northern parts is about a month later than that in the southern, allowance must be made accordingly.

BEE-EATER, a bird. See *Merops*, under ORNITHOLOGY.

BEE-FLOWER, a species of Ophrys, a genus of plants belonging to the Gynandria class.

BEE-GLUE, the propolis of the ancients, a glutinous matter with which bees cement the comb to the hive, and close up their cells. See BEE.

BEER, a fermented liquor obtained from an infusion of malted grain. See BREWING.

BEERING, or BEHRING'S ISLAND, an island in the North Pacific ocean, in the 55th degree of N. latitude, and forming one of the group called Aleutian islands, derives its name from the discoverer, commodore Behring, who was driven upon it in 1777; and, after experiencing the severest hardships, fell a victim, along with many of his crew, to the rigours of the climate. See ALEUTIAN ISLANDS.

BEERING, or BEHRING'S STRAITS, the channel which separates the continents of Asia and America, in the 65th degree of north latitude, and is about 40 miles in breadth; was discovered by commodore Behring in 1728, whose name it bears. In 1778 this strait was explored by captain Cook, and in the succeeding year by captain Clerk; several geographical positions were settled by these celebrated navigators; the depth of the water in the channel did not exceed 20 or 30 fathoms; and a remarkable similarity in the low naked shores with elevated land in the interior of the country, was observed on both sides of the straits. Three small islands occupy the middle of the channel. In 1790 Behring's straits were visited by some ships sent out by the Russians; but in all attempts to reach higher latitudes, immense fields of ice have always presented an insurmountable barrier. Cook's *Voyages*. Coxe's *Russian Discoveries*.

BEGUINS, a religious order of nuns, which was first established at Liege about the beginning of the 13th century, and spread over Flanders, the Low Countries, and Germany. The most flourishing societies of this order were in Antwerp, Malines, and Amsterdam.

BEHEMOTH, the scriptural name of a large and strong animal, supposed by naturalists to be the riverhorse or hippopotamus, which see under MAMMALIA.

BEHEM, or BEHEIM, MARTIN, a navigator of the 15th century, for whom the honour of the discovery of America has been claimed. He was a native of Nuremberg in Germany, and was early attached to the study of astronomy and navigation, in which it is probable he was encouraged by his instructor, the celebrated Regiomontanus, or John Muller. Endowed with an enterprising spirit, he made an offer of his services to Isabella of Portugal to undertake a voyage of discovery; being provided with a vessel, he sailed westward in the Atlantic ocean; and in 1460 discovered Fayal and the other islands of the Azores. He obtained a grant of Fayal, established a colony, and resided on it for about twenty years. In 1484 he was furnished with ships by John II. king of Portugal for another expedition, in the course of which he discovered Brazil and the straits of Magellan. As a reward for these remarkable discoveries, he was loaded with the most distinguished honours by the king of Portugal.

In 1492, the remarkable year of the discovery of America by Columbus, Behem visited his native city; and during his residence there, it is said he constructed a terrestrial globe, which is still preserved at Nuremberg. On this globe are traced the course of his own voyage, and the western regions, supposed to be the coast of Brazil, which he discovered.

The claims advanced for Behem are of a doubtful character. It seems to be quite unaccountable how so remarkable a discovery should be kept in profound silence for the period of eight years; and even long after the fame of the brilliant enterprise of Columbus, no notice was taken of any previous claim. The construction of the globe in the very year in which Columbus made his discovery, if the evidence of that fact be indisputable, presents a singular coincidence, and excites some suspicion that the dates may not be precisely stated. Behem died at Lisbon in 1506. Those who wish to see the claims of this navigator more fully considered, may consult a Memoir in the 2d volume of the American Philosophical Transactions

BEIRA, a province of Portugal, which is bounded by the river Douro on the north, by the Tagus and part of Estremadura on the south, by the ocean and part of Estremadura on the west, and by the Spanish territory on the east; is about 30 leagues square, and presents a diversified surface of steep mountains and fertile valleys.

The rocks of which the mountains are composed belong chiefly to the primitive class. Granite, micaceous, and argillaceous schistus predominate in the lofty ridges, and are succeeded at a lower elevation by grey limestone alternating with coarse-grained sandstone; some indications of coal have been observed on the coast, but not of sufficient extent to encourage active operations. The Mondego, which is the principal river, traverses the greater part of the province, and in its course towards the ocean passes through many rich and beautiful valleys. The mountains are clothed with forest-trees, and the plantations of olive-trees are extensive.

The population of Beira is stated at 560,000. The chief towns are Coimbra, Lamego, Guarda, Aveiro, Almeida, &c. Some parts of the province are under good culture; and wheat, barley, and rye are raised. Indian corn is cultivated in considerable quantities, and crops of rice are obtained from the marshes along the banks of the Mondego. The fruits of Beira are abundant and excellent; and the oranges, which are of a superior quality, are enumerated among the exports, to which also may be added the produce of the vine. The more elevated districts afford good pasture to sheep and cattle.

BEJAPOOR, a province of the Deccan in India, is about 350 miles long, and about 200 miles broad; is traversed by a mountainous ridge, which is a branch of the western Ghauts, for more than 60 miles from the sea, is watered by numerous rivers, and includes a population of 7,000,000, of which the followers of Brahma form the larger proportion, and the rest profess the Mahometan creed. Bejapoor and Poonah are the principal towns; but there are others of considerable magnitude, in which extensive manufactures of silk and cotton are successfully conducted, and their commercial intercourse with the northern regions of India is prosperous and lucrative. This province, once an independent kingdom, has been torn with dissensions among rival or rebellious chiefs; but, by the prudent interference of the British government, in 1804, some degree of tranquillity was restored, and probably the same powerful influence may be requisite in future to keep them in subordination.

BEL, or BELUS, the supreme god of the ancient Chaldeans, is supposed to be the Nimrod of Scripture, and the Phœnician Baal, and the founder of the Babylonian empire. The statue of this god was set up and dedicated by Nebuchadnezzar in the plain of Dura, after his return from the Jewish war. Daniel, chap. iii.

BELEM, a town of the province of Estremadura in Portugal, stands on the north bank of the Tagus; is the burial place of the Portuguese royal family, and is remarkable for a monastery of singular and fanciful architecture. One of the churches is a fine Gothic structure. Belem could once boast of a royal palace. It is still the residence of wealthy tradesmen, and is adorned with a botanic garden and the royal gardens, which still remain. A tower and several batteries, with a small fort for the defence of the harbour of Lisbon, have been erected at no great distance. Belem is three miles west from Lisbon.

BELEMNITES, known by the name of *thunder-stones*, or *thunder-bolts*, are organised substances in a petrified state, which are found detached in beds of gravel or clay, or are embedded in limestone, and are generally supposed to be animal remains. They are of a conical form, internally of a radiated structure, and are from one inch to five or six inches in length. According to the opinion of Klein, the belemnites are the spines of a large species of sea hedge-hog.

BELFAST, the most populous town in the north of Ireland, stands on the north side of the river Lagan, in the county of Antrim, and at its influx into Belfast lough, or Carrickfergus bay, and is about 80 miles north from Dublin. Although Belfast can lay claim to some antiquity, yet it was only a small place in the beginning of the 18th century; but by the enterprising spirit and commercial activity of its inhabitants, it has become one of the most flourishing towns in the kingdom. In the modern part of Belfast, the streets are spacious and regular; the houses, which are chiefly of brick, are well built; and the public buildings, as the exchange, the linen hall, some of the churches, and the college, are plain, but elegant and commodious structures. A bridge of twenty-one arches forms the communication between Belfast and the suburbs in the county of Down. It was built about the time of the revolution, at the expence of L.12,000, contributed by the two counties. Commodious docks, and yards for building and repairing ships, have been constructed at Belfast. Vessels of moderate size unload at the quays, but ships of large burden discharge their cargoes three miles below the town. By late improvements, the depth of water has been considerably increased.

The population, stated at 13,000 in 1782, was estimated at 30,000 in 1810, but it is supposed that this number is underrated. The chief manufactures are linen and cotton, earthen ware, glass, and sugar; and along with ship-building, some cast iron founderies and chemical works are prosperously conducted. Beside the coasting trade, and the exchange of commodities with England and Scotland, the commercial intercourse of Belfast with America and the West Indies is very considerable. In 1809, the exports of linen, butter, salted provisions, and oatmeal, amounted nearly to L.1,911,000 Sterling.

The charitable institutions of Belfast are numerous and liberally supported; the various literary societies, and public libraries which have been established, afford ample evidence of the intelligence and taste of the inhabitants; private academies have been long successfully conducted; and the Academical Institution, the building of which commenced in 1810, and was completed at an expence of more than L.16,000, raised by subscription, will form a remarkable era in the history of Belfast. This institution embraces a wider field for the education of youth, and is intended to include all those branches of literature and science which are usually prosecuted by the general scholar. Teachers have been appointed in several departments; their labours have begun, and promise to be of incalculable benefit to the northern division of the kingdom.

BELGÆ, a people of ancient Gaul, who occupied that district of country which lies between the Rhine and Loire, and are particularly described by Cæsar in his Commentaries.

BELGIUM was a part of ancient Gaul. The name was revived by the French in their revolutionary progress in 1795, and applied to the Netherlands, which, with the bishopric of Liege, was annexed to France, and divided into nine departments. The whole is now included under the new kingdom of the Netherlands.

BELGRADE, the capital of the province of Servia in European Turkey, stands on the declivity of a hill at the confluence of the Save and the Danube; was formerly a strongly fortified and populous place, and is still distinguished for its commercial transactions. The caravanseray or public inn, the college, the exchange, and the bazars, or market-places, are the principal public buildings. The streets are covered with wood, as a shelter to those who are engaged in mercantile affairs. Not far distant from Belgrade, some magnificent aquæducts were constructed by the eastern emperors, and were repaired and extended by their successors.

The population of Belgrade is estimated at 25,000; the situation is peculiarly favourable for commerce, having the commodious communication of the Danube with Germany and the rest of Europe on the one hand, and with the Black sea and the regions of the East on the other; and hence it is the constant resort of merchants from all these countries. The distance from Constantinople is stated at 440 miles north-west.

Regarded as the key to Hungary, Belgrade has

Belisarius. Bell.

been often the scene of severe struggles for its possession between the Turks and Austrians. It was taken by Solyman the Magnificent in 1521; recovered by the Austrians in 1688; and again, in 1690, after a cruel massacre, fell into the hands of the Turks, to whom nine years afterwards it was confirmed by treaty. But the most sanguinary contest which Belgrade had yet witnessed, was exhibited in 1717, when prince Eugene with 90,000 men laid siege to the place, on the 16th of August of that year attacked a Turkish army of 200,000 men which had come to its relief, and, after a terrible slaughter, obtained a complete victory and possession of the town. After another fruitless attempt, and the demolition of the fortifications, the Turks became its masters by treaty in 1739. It yielded again to the Austrians in 1789, and was restored by the peace of 1791, since which time it has continued in possession of the Turks.

BELISARIUS, a celebrated general under the emperor Justinian, is supposed to have been a native of Thrace, and rose from the humble rank of one of the private guard to the distinguished station of commander of the imperial armies. Having performed the most splendid exploits, and in the progress of his victorious career in the east and the west, in Italy and Africa, having added innumerable laurels to the Roman arms, and acquired the highest military reputation, he was falsely accused of a conspiracy against the emperor. The real conspirators were detected and seized with arms concealed under their garments. One of them fell by his own hand, and another, torn from the sanctuary to which he had fled, being tempted by the hopes of safety, charged two officers of the household of Belisarius, who being subjected to torture, declared that their patron was implicated in the crime. "Posterity will not hastily believe that a hero who, in the vigour of life, had disdained the fairest offers of ambition and revenge, should stoop to the murder of his prince, whom he could not long expect to survive. His followers were impatient to fly; but flight must have been supported by rebellion, and he had lived long enough for nature and for glory. Belisarius appeared before the council with less fear than indignation. After forty years service, the emperor had prejudged his guilt, and injustice was sanctified by the presence and authority of the patriarch. The life of Belisarius was graciously spared; but his fortunes were sequestrated; and from December to July he was guarded as a prisoner in his own palace. At length his innocence was acknowledged; his freedom and honours were restored; and death, which might be hastened by resentment and grief, removed him from the world about eight months after his deliverance. That he was deprived of his eyes, and reduced by envy to beg his bread, "Give a penny to Belisarius the general," is a fiction of later times, which has obtained credit, or rather favour, as a strange example of the vicissitudes of fortune." The source of this idle fable is traced to a miscellaneous work of the 12th century, the Chiliads of John Tzetzes, a monk, who relates the blindness and beggary of Belisarius in ten vulgar or political verses. This moral or romantic tale was imported into Italy with the language and manuscripts of Greece, and repeated before the end of the 15th century by several authors.

Belisarius died in the year 565, leaving behind him the character of a consummate general,—humane and liberal to his soldiers, whom he kept at the same time under the most rigid discipline,—not less humane and tender to those whom victory had put into his power,—and remarkable for his humility in prosperity, for his temperate habits, and his forbearance and self-denial in the midst of all his good fortune. Gibbon's *Roman History.*

BELL, a machine which produces sound, for the purpose of communicating different kinds of signals, and which is sometimes employed as a musical instrument. The form, size, and uses of bells are extremely different. An alloy of copper and tin is usually employed in casting bells; and hence it is known by the name of *bell-metal.* In most bells that have been examined the proportions are nearly the same. The component parts of bell-metal have been found to be 75 of copper and 25 of tin, or three of copper and one of tin. In fragments of bells that have been subjected to analysis, a small proportion of other metals has been detected, such as zinc, antimony, bismuth, and silver. But these metals are not supposed to be essential to the alloy, although it is probable the sonorous property may be somewhat modified by the addition.

The form of bells varies in different countries, approaching in some cases more nearly to that of the cylinder, and in others to that of the cone. But, according to Reaumur, the best shape of a bell would be that of the segment of a sphere, for even lead, which is the least elastic of the metals, when cast into this form, is very sonorous. In large bells a certain proportion is sometimes observed between the thickness and the size; the thickness of the edge is one-fifteenth of the diameter, and the height is twelve times the thickness.

Uses of bells.—Whatever may have been the origin of bells, their use, which has been very various, may be traced to the remotest antiquity. The sacred vestments of the Jewish high-priest were decorated with golden bells, for the purpose, it is supposed, of announcing his presence, of communicating to the people the moment that he entered the sanctuary. The garments of the ancient kings of Persia were furnished with bells in a similar manner, and, it has been conjectured, for the purpose of giving warning of their approach, that those who should be admitted to their presence might be prepared to express the proper degree of respect and veneration. Bells were in use among the Greeks to call the people together to religious exercises, as a signal for the sale of provisions, and as a warning to the sentinels on duty in a camp. The Romans announced to the people the preparation of the baths by the ringing of bells; and as bells were suspended from the gates of their temples, it appears that they were employed in the same way, or in some part of the religious service.

The practice of hanging bells from the necks of animals, which is alluded to by ancient writers, has been continued in modern times, and is intended to prevent the depredations of rapacious wild animals among herds and flocks, or, according to some, to answer some superstitious end. To a similar use are assigned the bells worn by the leading horses or mules employed in carrying loads on their backs, as was formerly the case in Britain before the improvement of the roads and the introduction of carriages, and is the case at the present day in many parts of the continent.

Bells were used in the churches of Italy, it is supposed, about the commencement of the 5th century, and before the end of the 7th they were introduced into England. In the beginning of the 11th century bells seem to have been part of the regular establishment of religious houses; for a portion of the revenue was appropriated to their purchase and repair. The Greek Christians, it is said, were unacquainted with bells till the ninth century, but they were afterwards prohibited by the Turks from using them. Such a prohibition might be expected from the followers of Mahomet, who, perhaps from policy, has excluded bells, to mark more strongly, even in trivial matters, the distinction between his system and Christianity.

Bells appropriated to churches and religious houses were formally consecrated and named about the tenth century. The episcopal benediction was pronounced, and the honour of the name was usually assigned to some saint. In the dark ages of superstition, the ringing of bells was practised for various purposes,—to warn all Christians to pray for the departing soul,—to drive away the evil spirits that hover in the air,—and to allay the fury of the storm and the tempest. The passing-bell of the present day no doubt refers to the same supposed influence, and the use of bells in modern times is well known. Beside the ordinary purpose of warning to the public exercises of religion, the ringing of bells is a signal of rejoicing on the occurrence of prosperous events, or anniversary festivals; and tolling is an expression of mourning during a funeral procession.

Ringing bells in change, or in regular peals, is said to be a practice peculiar to England, and hence this country has been designated by foreigners the *ringing island*. The bells employed in ringing peals have different tones, and by the skill and ingenuity of the performer a variety of musical sounds, and some degree of harmony, are produced. For the practice of this favourite art societies have been established; it is conducted according to certain principles, and peals which bear the names of the authors have been composed, and are much admired. But the perfection of the art in England seems to consist in the number and variety of the changes, and challenges between rival performers are not uncommon.

In some of the towns of Britain, as well as on the continent, regular tunes are played with bells, which are hence denominated music bells. The performance is conducted by means of keys like those of the piano-forte. It is supposed that music bells were introduced previously to the 14th century. The great tower of the cathedral in Antwerp is furnished with a splendid set of music bells. The number of bells is thirty-three, and the largest is eight feet in height, and seven feet in diameter. The fine tone of this bell is greatly admired.

Large bells.—In the history of bells, in different places of the world, their magnitude is not the least remarkable circumstance. Of three bells presented by Edward III. to St Stephen's chapel in Westminster, the largest was 33,000 pounds weight, which appeared from an inscription cast in the metal. The bell in the steeple in the great church at Rouen in Normandy, in France, according to its inscription was equal to 40,000 pounds weight. China is celebrated for large bells; the great weight of the bells in a tower at Nankin brought the building to the ground. The dimensions of one of the bells, which is of a cylindrical form, are 12 feet in height, and $7\frac{1}{2}$ feet in diameter. But of seven bells in Pekin each is said to weigh 120,000 pounds.

The bells now mentioned are far exceeded by the huge bell at Erfurth in Germany; it was cast in 1497; the clapper was 12 feet long, and weighed 1100 pounds; the whole weight is equal to 252,000 pounds, and the sound, in the direction of the wind, was heard at the distance of nine leagues. The bell in the tower of St Ivan, at Moscow, which is 114,000 pounds weight is $13\frac{1}{4}$ feet in diameter, and $16\frac{3}{4}$ inches thick. These are still exceeded by a bell at Moscow, which was made in 1653, but it was never removed from the pit in which it was cast. The scaffolding over it accidently took fire, and the water employed in the extinction of the flames, coming in contact with the heated metal, produced a fracture on one side, which rendered it useless. The rim is buried in the the earth, but the diameter, two feet above the ground, is 22 feet 5 inches, the perpendicular height is more than 21 feet, the thickness 23 inches, and the whole weight equal to 443,772 pounds. This bell, it is said, contains a large proportion of silver in its composition, for the nobles and people contributed a great deal of money and plate, which they threw in as votive gifts while the metal was in fusion. This bell, it is added, is held in superstitious veneration by the Russians, and is visited by peasants on festival days; but it seems more probable that it is regarded as an object of curiosity on account of its extraordinary magnitude.

BELL-ROCK LIGHT-HOUSE, on the eastern coast of Scotland, is 11 miles south-west from Redhead in Forfarshire, 12 miles from Arbroath, 17 miles north-east from the May light-house, and 30 miles north by east from St Abb's head. Its geographical position is in 56° 29′ of north latitude, and 2° 22′ of west longitude. The rock is composed of red sandstone, similar to the strata of the contiguous promontory of Forfarshire and of the shores of Berwickshire. During low water of neap tides, a very small part of the rock is seen at low-water; but during the lowest ebbs in spring-tides, a space equal to 427 feet in length, and 230 in breadth, appears about 4 feet above the surface of the water; and from the floating sea-weed, the ridge can be traced 1000 feet farther in a south-westerly direction, when the tides are very low. Such a mass of rock concealed from view during great part of every tide, was an object of great danger to the numerous vessels which navigate that coast. The means of obviating these dangers were long under the consideration of those to whom this department of maritime affairs is en-

Bell-rock. Bellarmin.

trusted; and indeed, at a very early period, if the traditionary story be true, an attempt was made by the abbots of Arbroath to erect a bell, which was rung by machinery, acted upon by the motion of the tides, to warn the mariner of his danger; and hence it is said the name of Bell-rock is derived.

By a legislative enactment which was passed in the year 1806, the commissioners of northern light-houses were empowered to levy a duty from all vessels frequenting the ports between Peterhead and Berwick; and after various plans for a light-house were suggested, a structure similar to the Eddystone was adopted. Considering the near resemblance of the two situations, it is somewhat remarkable that any other plan for a light-house on the Bell-rock should have been for a moment contemplated than that of the Eddystone, which has so long resisted the tremendous fury of the billows rolling into the channel from the Atlantic ocean, and is one of the noblest monuments of the genius and perseverance of Smeaton, who planned and conducted the work.

Construction of the light-house.—Early in 1807, the preparation of the materials for building the light-house commenced. The stones were obtained from the granite quarries in Aberdeenshire, or from sandstone quarries in the vicinity of Dundee and Edinburgh, and they were either prepared on the spot from which they were dug, or in the yard established at Arbroath for the use of the undertaking. The cement was a mixture of puzzolana earth, lime, and sand, in equal proportions. When the operations commenced at the rock in August, the first object was the erection of a wooden beacon-house, for the safety of the workmen, in case any accident should happen to the boats which were in attendance to carry them to the vessel with the floating light, which was moored at the distance of a mile and a half. This temporary edifice, supported by large beams of fir timber, was raised 50 feet above the surface of the rock. The upper part of it was afterwards fitted up as a smith's forge, a kitchen, and lodgings for the engineers and workmen. The beams were set up by the end of October, and the different apartments were prepared in the early part of the ensuing summer. The foundation stone was laid on the 10th of July 1808, and in the close of the season four courses, which raised the height of the building five feet six inches above the foundation, were finished.

When the operations were resumed in the spring of the year 1809, it appeared that the works of the preceding season had not sustained the least injury from the severity of the winter storms; and during this summer the building was raised to the height of 30 feet. This completed the solid part of the edifice. All the materials for finishing it being collected and prepared, the operations commenced as early as the weather permitted in 1810; and by the activity and experience of both seamen and artificers, the whole was completed in the month of December, and the new light was exhibited on the first of February 1811.

Description of the building.—The Bell-rock light-house is a solid mass of building from the foundation to the height of 30 feet. The two lower courses of the masonry are imbedded in the rock. The outside casing is of Aberdeen granite; the internal parts of the solid mass are sandstone. The stones employed were from two tons to half a ton each in weight, and the stones of each course are not only connected together, but the different courses are firmly united to each other. The foundation of the building is forty-two feet in diameter, and it diminishes gradually to the top, where the diameter is only thirteen feet. The lower part of the walls is seven feet thick, and they also diminish to one foot in thickness at the parapet wall of the light room. The masonry is 100 feet in height, and the height of the whole edifice, including the light room, is 115 feet.

Beside the light-room, the Bell-rock light house contains five apartments for the accommodation of the light keepers, and for the reception of provisions and necessary stores. The light-room is of an octagonal form, 12 feet in diameter and 15 feet in height, formed of cast iron sashes, filled with plate glass nearly $2\frac{1}{2}$ feet square, and 1-4th of an inch thick, and it is covered with a copper dome. The light is obtained from oil burnt in Argand's lamps, placed in the focus of silver-plated reflectors. By means of machinery, the whole lights move round on a perpendicular axis every six minutes; and during each revolution, a bright white light, a red light produced by the interposition of red glass, and alternate intervals of darkness, distinguish the Bell-rock light from every other. In hazy weather two large bells are tolled day and night by the same machinery.

Four light keepers are appointed to the Bell-rock, at salaries of 60, 55, and 50 guineas yearly, beside a stated allowance of provisions, and other perquisites, when on duty, and apartments for their families at Arbroath. Three of them always attend at the light-house for six weeks, while one is permitted to be on shore for a fortnight, during which time he takes charge of the signal tower at Arbroath, from which a correspondence is kept up with the light-house by signals.

The whole expence of this remarkable edifice is stated at L.60,000; and the skill and perseverance of the engineer Mr Stevenson, in the speedy and successful completion of so arduous a work, have been only equalled by his great predecessor Mr Smeaton, in a similar undertaking.

BELLARMIN, Robert, an Italian Jesuit, and one of the ablest controversial writers of his age, was a native of Tuscany, and was born in 1542; in his 18th year he entered the society of Jesuits, and when he was admitted to the priesthood, from being a near relation of the reigning pope, saw the path of ecclesiastical preferment open before him. Appointed professor of divinity at Louvain, he delivered lectures for seven years, which were characterised by ingenuity and acuteness; and repeating them at Rome, when he returned to his own country, he acquired a high degree of reputation. Being engaged in various public missions by three successive popes, he was at last raised to the dignity of cardinal, which it is said he reluctantly accepted; was afterwards elected archbishop of Capua, and was excluded from the chair of St Peter only because he belonged to the order of Jesuits. His powerful talents rendered his services of great importance to the church; and during the latter years of his life he resided constantly at the court of the Vatican. His growing infirmities required him to withdraw from public affairs in 1621, and he died in the same year, at the advanced age of 79. Bellarmin was a voluminous and elaborate writer. His principal work, *A Body of Controversy*, in four volumes folio, which has been often quoted by his opponents, is distinguished by fairness and candour, clear arrangement, ingenious reasoning, and plain, nervous language.—*Gen. Biography.*

BELLEISLE, an island in the bay of Biscay, included in the department of Morbihan in France, and about fifteen miles from the coast; is about twelve leagues in circumference; the shores are rugged and precipitous, and the surface is partly rocky and barren, and partly covered with good soil, which produces some grain. The inhabitants, the number of which is variously stated from three to 5000, are chiefly employed in the pilchard fishery, which is abundant and lucrative, and is the principal source of their commercial intercourse with other parts of France and some parts of Spain. Besides Palais, the chief town, numerous villages are scattered over the island. An unsuccessful attempt on this island was made by the British in 1761, and in the repulse 500 men were slain. In a second attack possession was obtained; but it was restored by treaty in 1763.

BELLENDEN, John, a Scottish poet, who flourished in the 16th century; but the records of his life are so scanty that little is known of the time of his birth, or of the place of his education. He was archdeacon of Moray, and it is supposed that he died at Rome in 1550. He was in great favour with James V. of Scotland, at whose suggestion he undertook the *History and Croniklis of Scotland*, which is a free translation of the first seventeen books of Hector Boyce's history. Two poems, the *Proheme of the Cosmographe*, the chief incidents of which are derived from the ancient allegory of the choice of Hercules, and the *Proheme of the History*, appear in the same publication, which is concluded with a prose epistle addressed to the king. The noble enthusiasm which pervades the poetry of Bellenden has placed him in the first ranks of the poets of his country; and, with a fine fancy and cultivated taste, his learning was extensive and profound.

BELLEROPHON, a celebrated character in ancient mythology, was the son of a king of Epirus; and having accidentally killed his brother, fled to the king of Argos for protection. His queen, disappointed in her attempt to seduce the stranger, brought a false charge against him, but the king, doubtful of its truth, or unwilling to inflict punishment, sent him to his father-in-law, the king of Lysia, by whom he was employed in several hazardous enterprises. Bellerophon not only escaped the danger to which he was exposed, but returned victorious. One of his exploits was the destruction of the Chimæra, in which he was greatly aided by the horse Pegasus, furnished by Minerva or Neptune.

His royal host, convinced of his innocence and integrity, and delighted with his heroism, gave him his daughter in marriage. But prosperity made him vain and ambitious. With his divine animal he attempted to scale the celestial regions. Jupiter, to check his presumption, struck him blind, and threw him down to the earth, on which he wandered a miserable spectacle of divine wrath till his death; but, by the permission of Jupiter, Pegasus ascended to heaven, and was placed among the constellations.

BELLES LETTRES, a French expression, literally signifying *fine letters*, is a term of common occurrence, and may be considered as naturalised in the English language, but with no very definite meaning, is nearly equivalent to the phrase *polite literature*, of equally general import, and is usually understood to refer to knowledge of grammar, criticism, and what may be considered the ornamental branches of learning.

BELLIS, the Daisy, a genus of plants belonging to the Syngenesia class, of which the well-known common daisy, *bellis perennis*, is a species.

BELOOCHISTAN, or Baloochistan, an extensive region of Asia, on the north-west coast of the Indian peninsula, has the Indian ocean for its boundary on the south, Affghanistan on the north, the Persian territories on the west, and Sinde on the east; extends from the 25th to the 30th degree of N. Lat. and from the 58th to the 68th degree of E. Long. and includes an area of more than 150,000 square miles. This district is traversed in various directions by mountainous ridges, some of which rise to a great elevation. The rivers are to be regarded as mountain torrents, which flow down with irresistible rapidity during the rainy season, and, when the drought prevails leave a dry channel.

The mountains afford metallic ores, such as those of iron and copper, which are smelted and manufactured, and even some of the more precious metals. The climate and soil are various. Some districts are fertile, and produce corn and fruits in abundance. In the desert and less frequented tracts, wild animals of the fiercer kinds are not uncommon. Kelat, which is walled and fortified, is the principal town and capital of the country, and, including the suburbs, contains about 4000 houses constructed of wood or half-burnt bricks. The houses are lofty, the streets are narrow, and the projecting upper stories cast a gloomy shade on the vacant space below.

Many of the native tribes of this district lead a pastoral life, live in tents, and, like other wandering tribes, are not scrupulous of engaging in plundering warfare. They are all believers in the Koran. Each tribe is said to elect its own chief, but this choice, it is probable, most frequently falls on the strong and powerful. The khan, or prince to whose authority all the chiefs submit when he possesses the means of enforcing it, resides at Kelat. But, like other rude states, the government of Beloochistan has been subject to many vicissitudes.

BELLONA, the goddess of war of ancient mythology, is variously described as the sister, wife, or daughter of Mars, for whom she prepared the chariot, and is commonly represented in a state of fury and distraction, her garments stained with blood, and her snaky hair clotted with gore; and with a trumpet, a lighted brand, or a bloody whip in her hand, she drives the chariot of the god of war. Temples were erected to the worship of Bellona at Rome and in the provinces, among which it is recorded that one was dedicated to the same goddess in York in England, in the time of Severus.

BELLONIA, a genus of plants belonging to the

Pentandria class, of which the only species is a native of the warmer parts of America, and is named to commemorate Peter Belon, a French naturalist of the 16th century.

BELLOWS, a machine for blowing air with violence, for the purpose of increasing the heat of common fires, furnaces, and forges, or for producing sound in organs and other musical instruments. When bellows are employed on a large scale, and when the pressure of water is brought into action to produce a uniform and uninterrupted current of air, the apparatus thus constructed is called a *blowing machine*, for an account of which see FURNACE.

BELLUNESE, a mountainous district of Italy, included in the Venetian territory, part of which is clothed with extensive forests, from which large quantities of timber are floated down the river to Venice; part affords excellent pasture to numerous herds of cattle, and part yields abundant crops of corn and fruits. Metallic ores abound in some of the mountains. The population exceeds 47,000. A dreadful disaster happened in this district in the year 1774. A mountain, thrown down by an earthquake, filled up the bed of a river, buried under its ruins seven villages, with all their inhabitants, and formed a permanent lake two miles in length, and half a mile in breadth.

BELLUNO, the capital of the Bellunese in Italy, stands on the banks of the river Piava, contains more than 7000 inhabitants, and, by means of the navigable river, has a considerable trade. Belluno is adorned with many fine buildings, some splendid marble monuments, and numerous churches, monasteries, and hospitals.

BELON, PETER, a French naturalist, who flourished about the middle of the 16th century, and published various works on birds, fishes, serpents, &c. which are occasionally quoted by later naturalists, and an account of his travels in Greece, Egypt, Arabia, and other eastern countries. He lost his life by the hand of an assassin, near Paris, in 1564.

BEMBA, or BEMBEA, a province of Angola, which stretches partly along the coast, is said to be extremely populous, and abounds with cattle. The river which traverses this province swarms with crocodiles and river horses. Numerous serpents infest the less frequented parts of the country; but serpents devouring fish must either be admitted as a fact unknown to naturalists, or must be regarded as an exaggerated tale imposed on the credulity of some traveller; and perhaps the story of the inhabitants clothing themselves with the skins of cattle may be traced to the same source. The natives of warm climates neither require nor make use of such a dress.

BEMINSTER, a town of Dorsetshire, in England, is finely situated in the midst of gardens and orchards, in a fertile valley, on the banks of the river Bist. The population exceeds 2000, and manufactures of woollen stuffs and sail-cloth, of iron and copper wares, are established. Beminster is 12 miles from Dorchester, and 138 miles west from London.

BENARES, a province of Hindostan, in the East Indies, which is bounded on the east by Bahar, and on the west by Allahabad, and extends about 70 miles in length, and 25 miles in breadth, is very populous, and possesses a rich and fertile soil. This country was ceded to the British in 1775, and, it is said, affords a clear annual revenue of L.400,000 sterling.

BENARES, the capital of the district of the same name in the East Indies, is celebrated as the ancient seat of Brahminical learning, stands on the northern bank of the Ganges, about 460 miles north-west from Calcutta. The streets are in general narrow, and approach so near in some places that they are united by galleries. The houses are built with stone, and some of them are raised six stories high, each of which is inhabited by a different family. The windows are extremely small, for the purpose, it is supposed, of precluding opposite neighbours from seeing into the apartments, or for preserving coolness during the prevalence of hot winds. A large proportion of the houses of Benares is constructed of mud; but the more opulent inhabitants possess detached houses, which have open courts, and are inclosed by walls. The banks of the river are embellished with numerous Hindoo temples, and many of the public and private edifices are magnificent structures. In the centre of the city a large mosque, with its towering minarets, was raised by the emperor Aurengzebe, on the same spot which was occupied by a splendid Hindoo temple, and is regarded by the natives as an insult and profanation of their worship.

In the vicissitudes of its fortunes, Benares has greatly declined; but many monuments of its ancient splendour yet remain. The celebrated Observatory, which is furnished with numerous astronomical instruments, formed of stone, and constructed with great accuracy, is still preserved, and Benares is yet resorted to by students from all quarters, to be instructed in the literature and science of the east.

The population of Benares has been variously estimated at 150,000, from three to four hundred thousand, and, according to some calculations, the number of inhabitants exceeds half a million. During certain festivals, an immense concourse of pilgrims resorts to Benares from all parts for the purpose of performing their devotions; and the pictures of hunger, wretchedness, and disease which present themselves among the multitudes assembled on these occasions, as they are described by travellers, seem to exceed belief.

BENCOOLEN, a sea-port town on the south-west coast of Sumatra, stands on morassy ground, and is above two miles in circumference. The houses are raised on bamboo pillars, the inhabitants are occupied in fishing, and in the culture of rice and pepper, which is the chief commercial commodity. The surrounding country is mountainous, and clothed with wood; and a spacious and commodious bay stretches for several leagues in front of the town.

BENDER, a fortified town, and capital of Bessarabia in Turkey in Europe, stands on the banks of the Dniester; and before the memorable and disastrous siege in 1770, when it was invested and stormed by the Russians, the population amounted to 30,000, but by famine and war was reduced to less than half the number. The fortress, erected in consequence of the dying command of Bajazet II. to his successor, is remarkable for a spacious ditch, is well furnished with cannon, and fully supplied with ammunition of all kinds. The mosques, some of which are fine edifices, gates of the town, and inns, are numerous; but the streets are narrow, gloomy, and dirty. Manufactures of leather and paper have been established; and part of the inhabitants is occupied in watch-making, and in the construction of implements and utensils of iron. Bender is memorable in history as the place to which the famous Charles XII. of Sweden retired after the battle of Pultowa, when he sought an asylum from the Turks; and the ruins of the house in which he resided, and some remains of the entrenchments which he constructed are yet visible.

BENEDICTINES, an order of monks which was instituted in the year 529 by St Benedict, from whom the name is derived. The corruptions which had crept into the other monastic institutions brought them into disrepute; and the regular system of discipline which prevailed in the rule of St Benedict soon gave it a high degree of celebrity. About the 9th century the Benedictines had taken place of almost every other order in France, Italy, Germany, and England. The decline of the order is dated from the middle of the 10th century; and in the attempts to reform and restrain the irregularities which marked their conduct, they were at last in a great degree superseded by the order of Clugny, which became no less celebrated throughout Europe.

BENEDICTION, a form of prayer or thanksgiving pronounced sometimes on more ordinary and sometimes on more solemn occasions. Among Christians the short prayer before meals, and the expression of thanks after a repast, come under the denomination of benediction. The patriarchs, in the prospect of death, left their blessing with their families; certain forms of benediction were established among the Jews; and similar practices prevail both among Christians and Mahometans. Among the latter, indeed, it is often little different from the friendly forms of salutation in common life. Benediction may be regarded as part of the ceremony of consecration in the Christian church, when a person, or even an inanimate object, is set apart for the service of religion.

BENEVENTO, a city of Naples, which is chiefly remarkable for numerous remains of Roman antiquity. The *porta aurea*, or golden gate, one of the entrances to the city, is a splendid monument of white marble, erected by Trajan, about the beginning of the second century, to commemorate the wars in which he had been engaged with the Dacians; and fragments of tombs, altars, and ornamental pieces of architecture are seen in the walls of every modern house in one part of the town. The population of Benevento is stated at 10,000, and the distance from Naples is 30 miles.

BENGAL, a province of Hindostan, which has the bay of the same name for its boundary on the south, Orissa and Bahar on the west, Assam and Bootan on the north, and on the east a mountainous range which forms a natural limit between it and Arracan and the Birman territory. Bengal extends from the 21st nearly to the 27th degree of north latitude, and from the 86th to the 93d of east longitude; and the greatest length from east to west is about 700 miles, and the greatest breadth from north to south is about 300 miles.

Climate.—The climate of Bengal is subject to great extremes of heat and cold. During the hot season, which commences with March, and continues three months, the thermometer often rises to 100; in the cool season, between November and February, the north winds chiefly prevail, and the sky is serene and unclouded; but from June to October, in the intermission of the heavy rains, thick fogs are common, and the weather is sultry and oppressive.

Aspect and soil.—In the south-west corner of the province, and on the north of the Ganges, the country rises to a considerable elevation; but Bengal, in general, is to be regarded as a flat region, traversed by numerous rivers. The majestic streams of the Ganges and Burrampooter flow through the richest districts of Bengal, and in their annual inundations communicate a high degree of fertility to the contiguous lands. The Ganges discharges its waters into the ocean by several branches, which intersect the lower district, or Delta, in various directions. The whole region which extends from the river Hooghly to Chittagong, is distinguished by the Indian name of *Sunderbunds*, or woods, and is altogether an uninhabited waste, the dreaded abode of the tiger, and other ferocious wild animals. The soil of Bengal is a blackish mould, chiefly composed of clay and sand, abounding with vegetable and animal substances, and often impregnated with saline matters.

Inundations.—The inundations which form so striking a feature in the natural history of Bengal, and are so essential to the produce of the soil, arise from the torrents of rain which fall in the lower districts of the province, and from the melting of the snows near the distant sources of the great rivers. About the end of April the waters begin to rise, and by the end of July all the low parts of the country in the vicinity of the Ganges and Burrampooter are overflowed, when nothing is to be seen above the liquid surface but villages and trees, for an extent of more than a hundred miles. The inundation is stationary for some days previously to the middle of August, after which it begins to subside, and in October the land, highly fertilized, is ready for culture.

Agriculture.—Rice, which forms the principal food of a large proportion of the natives, is very extensively cultivated; but wheat and barley grow in some districts; and Indian corn, millet, and a great variety of pulse, are also raised. The sugar cane, poppies for the extraction of opium, mulberry trees for rearing the silk worm, tobacco, cotton, and indigo, are also objects of culture. But the culture is extremely imperfect; little skill or attention appears in the preparation of the land; the implements of agriculture are rude, and the operations are slow and awkward.

Natural productions.—All the rich fruits of tropical regions are abundant in Bengal; various kinds of excellent timber are produced, and applied to domestic purposes or the arts; and some of the more valuable medicinal drugs form important commercial commodities. The nature of the climate, and the secure retreats which the country affords, are highly favourable to the multiplication of every description of animals.

Inhabitants.—Of the population of Bengal, no certain estimate has been formed; but, according to a statement, to which little accuracy can be attached, it contains nearly 15,000,000 inhabitants, or about one half of the population subject to the British government in India. They are distributed in forty or fifty large towns, and a great number of populous villages. Calcutta, comparatively a modern town, is the capital of the British settlements in the East, and the residence of the governor-general. The native Hindoos compose four-fifths of this vast population. The rest are Moguls, of Tartar origin, who conquered the country in the fifteenth century. The Mogul inhabitants have an olive complexion, and resemble Europeans in the general cast of their features. They profess the Mahometan faith, are fierce enemies of the Hindoo idolatry, and, in spite of the restraining influence and power of the East India Company, express their abhorrence by persecution and bloodshed. The native tribes are the followers of Brahma. They are slender and handsome in their persons, their complexion is dark-brown or yellowish, and the hair is black, long, and straight. The practice of shaving the head is common; a piece of linen or cotton thrown round the middle is all the clothing of the lower classes; but the higher ranks wear turbans, and a dress of white cotton, which covers the whole body.

Manufactures.—Like other Asiatics, the natives of Bengal are distinguished for their manual dexterity in mechanical arts. With the simplest apparatus they produce the most beautiful fabrics of all kinds of cotton and silk goods; and the same delicacy of hand is not less conspicuous in the nicer and minuter operations of working in metals, and fabricating utensils and trinkets for domestic use or ornamental purposes.

Commerce.—The navigable rivers of Bengal afford great facilities for commercial intercourse with the interior regions of India. A great trade in silks, cotton goods, sugar, indigo, and medicinal drugs, is carried on with Agra, Delhi, and Thibet. Of the extent of this trade some conjecture may be formed, when it is stated, that 30,000 boatmen are employed in inland navigation. The boats, or *budgeroes*, are variously constructed, according to the nature of the stream which they navigate. They draw from four to five feet of water; and they are sometimes fitted up with spacious cabins for the accommodation of passengers. At different periods of the year, and in different states of the river, the progress of the boats varies from 17 to 20 miles, when dragged against the stream, and proceeding with the current at the rate of 40 and 70 miles a day.

The maritime trade of Bengal is also considerable, and, in the hands of natives or Europeans, extends either directly or more circuitously to almost all the islands and countries in the eastern quarter of the globe. The Armenians, who have been long celebrated for their sagacity and success in mercantile affairs, enjoy no small portion of this trade.

European settlements.—In the beginning of the 17th century the English established their first settlement in Bengal, at the town of Hooghly; but in 1689 it was removed to Calcutta, 26 miles down the river; and after numerous conflicts in the field with the Mahratta states and the native princes, they obtained in 1765 the supreme government,—an era which has been justly regarded as highly favourable to the great mass of population, which is now under the equal protection of British authority. The French, Dutch, and Danes, had formerly settlements in the same province.

BENIN, a district or kingdom of Guinea in Africa, has, for its boundary on the west, part of the gulf called by mariners the *Bite of Benin*, and the Slave Coast and Congo on the south, extends about 600 miles from east to west; is in general a low, flat country, covered with woods, part of which is intersected by rivers and lakes, and part is entirely destitute of water; and yields in great profusion most of the vegetable productions of tropical regions, as well as the various birds, quadrupeds, reptiles, and insects, which abound in warm countries. Indian corn, yams, and bananas, are cultivated as the chief food of the inhabitants. The climate is extremely insalubrious; thick fogs are very prevalent; and tremendous storms of thunder and lightning are not rare.

The principal labours of the field, as well as domestic concerns, and even it is said, in some erroneous accounts, the handicraft arts, are assigned to the women. The character which has been drawn of the inhabitants seems to be altogether inconsistent with itself. They are represented as friendly, hospitable, and generous; their institutions, it is asserted, breathe the purest spirit of humanity; the aged and infirm are gratuitously supported; no one is allowed to pine in want, and beggary is altogether unknown; but, on the other hand, they are described as indolent in the extreme, and, unless they are compelled by poverty, never submit to any kind of manual labour. From all this it appears that they are a lazy barbarous people, and their reputed virtues only exist in the partial narratives of credulous travellers. The Portuguese had formerly settlements in this country, and the slave trade was at one time considerable.

Benin is also the name of the capital of the country, and the residence of the king. The mud houses are covered with reeds or leaves; the streets are spacious, the market is well furnished with the productions of the country, and with European merchandise, for which they are to be exchanged; and the compass of the whole town is stated at four miles.

BENTLEY, Richard, a learned English critic, was a native of Yorkshire, and was born in 1662; was initiated in classical literature at the free school of Wakefield, and in his fifteenth year was admitted a student in St John's college, Cambridge. In the prosecution of his studies he was remarkable for assiduity and industry, of which a singular instance is recorded in the laborious undertaking which he executed of arranging alphabetically every word of the Hebrew bible, and marking in five separate columns, the various interpretations of the same words in the Chaldee, Syriac, Vulgate, Septuagint, and Latin bibles. The production of a thick quarto volume was the result of this mighty task; and another volume of equal magnitude was occupied with the emendations and various readings of the Hebrew text, collated from ancient manuscripts. After four years residence at the university, he was employed for some time in teaching a public school, and afterwards as a private tutor; and having been ordained to the priesthood, he was the first preacher appointed to deliver the lecture established by Mr Boyle in support of the doctrines of natural and revealed religion. His discourses on this occasion were published.

The appointment of Dr Bentley, in 1693, to be keeper of the royal library at St James's, in which his zeal and industry soon became conspicuous, was the prelude to more lucrative offices and higher distinctions; for, in 1700, he was raised to the mastership of Trinity college, Cambridge; soon after preferred to be archdeacon of Ely; and, in 1716, was nominated Regius professor of divinity in Cambridge.

From two events in his life, which obtained considerable notoriety, it may be presumed that Dr Bentley was not possessed of the most conciliating or courteous manners. Some severe remarks, delivered in a contemptuous tone, which escaped from the learned, and perhaps somewhat arrogant critic, on an edition of Phalaris published by the honourable Charles Boyle, produced a violent literary squabble, in the course of which it is generally admitted that Bentley proved the epistles ascribed to Phalaris to be spurious. The other incident alluded to, which was more serious in its consequences, was a dispute with his college, on some points of reformation, which provoked hostility from those who were immediately interested, and afterwards on a demand for additional perquisites, which was also resisted, and terminated in deprivation from all his privileges, honours, and degrees in the university. But an appeal to the king, and a reference to the council and the court of King's Bench, procured his re-instatement in all his offices and privileges, of which he enjoyed the undisturbed possession to the end of his life, which closed in the year 1742, when he had reached the venerable age of 81.

Two comedies of Aristophanes, Fragments of Menander and Philemon, editions of Terence, Phædrus, and Milton, and an edition of Horace, published in 1711, which acquired for him great celebrity, are the fruits of Dr Bentley's critical skill. He had circulated proposals for an edition of the Greek Testament; but the remarks of his literary antagonist, Dr Middleton, determined him to relinquish the undertaking, and return L.2000 of subscription money.

BENZOIN, a gum resin obtained from a species of styrax. See CHEMISTRY.

BERAR, a large and centrical province of the Deccan, in India, which extends from the 19th to the 22d degree of north latitude, is about 230 miles in length, and 120 miles in breadth, and has Allahabad for its boundary on the north, and Aurungabad and the Godavery on the south. The surface is in general elevated and hilly, and abounds in strong holds; it is well watered by numerous streams, of which the Godavery, Tuptee, and Poornah are the chief; is but thinly inhabited and sparingly cultivated, although in some places the soil and climate are extremely favourable for the production of wheat, barley, rice, sugar, cotton, opium, and silk, and the bullocks are reckoned the best in the Deccan.

The population is supposed not to exceed 2,000,000, of which one-tenth are Mahometans, and the rest are the followers of Brahma. Three-fourths of the province belong to the territories of the Nizam, and the remainder is tributary to the Mahrattas. Among the lowest tribes of Berar a singular kind of suicide prevails. In return for benefits solicited from idols, a solemn vow of self-destruction is made, and the supposed successful votary in the fulfilment of it throws himself from a precipice in the mountains between the rivers Tuptee and Nerbuddah. In the time of an annual fair near this spot, eight or ten enthusiasts fall victims to this superstition.

BERBERIS, the BARBERRY, a genus of plants belonging to the Hexandria class, one species of which, *vulgaris*, is a native of most parts of Britain.

BERBICE, a British colony in Guiana in South America, which derives its name from the river along whose banks it extends for 300 miles. The breadth is from 40 to 45 miles. The shores are low and swampy; the country continues flat far inland, and is covered with thick forests, in which trees of enormous magnitude shoot up. Like other intra-tropical climates, the seasons in this district observe a pretty regular succession of wet and dry weather.

Berbice is the principal river; it flows from south to north, and discharges itself into the Atlantic ocean; it is a mile broad at its influx into the sea in the 6th degree of N. latitude; but the entrance is partly closed by Crab island, so designated from the profusion of land-crabs which it produces. The Berbice is navigable for ships of considerable burden 200 miles into the interior; but a bank of sand opposes their approach, so that only small vessels can enter, and ships from Europe load and unload at Demerary. The Canjè, which falls into the river Berbice, about a mile from the sea, admits the navigation of small vessels for a course of 30 miles. In some parts of the colony canals have been cut to facilitate the conveyance of produce by water-carriage.

The population of Berbice, in 1811, is stated at 550 whites, 240 persons of colour, and 25,169 negroe slaves. Sugar, coffee, cocoa, cotton, anotta, and indigo are the principal productions. The only towns are Old and New Amsterdam; the former is about 50 miles up the river Berbice; the latter has risen chiefly since the colony became subject to Britain, and occupies the banks of the Berbice near the confluence of the Canjè; it is the seat of the colonial government; and except the public buildings, which are of brick, the houses are usually constructed of wood.

Berbice was settled by the Dutch in 1626: it fell under the dominion of Britain in 1796; was restored to the Dutch at the peace of Amiens; but in 1803, it was again reduced by British troops, and has since acknowledged British authority. But, by a legislative enactment in 1816, the Dutch colonists, who are subjects of the king of the Netherlands, have certain privileges of supplying their estates with necessaries only, and not for the purposes of trade, from the parent country, and of exporting their produce to the Netherlands; but this limited trade is to be conducted in Dutch ships.

BERCHTOLSGADEN, a principality which, along with Salzburg, forms a province of the Austrian empire, includes an area of nearly 200 square miles, and above 200,000 inhabitants. It is chiefly a mountainous district, and affords a considerable revenue from the salt-mines.

Berchtolsgaden is one of the chief towns, and contains about 3000 inhabitants, who are chiefly employed in the manufacture of wooden, bone, and ivory toys.

BERG, a duchy in the circle of Westphalia in Germany, is a mountainous district, which covers more than 1200 square miles of surface, and includes a population equal to 610,000. That part of the duchy which stretches along the Rhine has a fertile soil, which produces abundance of corn; the more elevated vallies afford excellent pasture; the vine thrives on the hills, and the mountains are clothed with thick forests. Mines of lead, iron, and coal are wrought; and swords, knives, and other instruments of iron and steel, ribbons, and various kinds of cloth, are the principal manufactures. Dusseldorf is the chief town. Berg, with Cleves, was constituted in 1806 a grand duchy by Bonaparte, and Murat was nominated grand duke.

BERGAMO, the capital of the district of Bergamasco in Italy, stands on several hills, and is strongly fortified, contains numerous churches and convents, and about 30,000 inhabitants, who enjoy a considerable trade in silk and woollen stuffs, and have been long celebrated for the excellence and beauty of their serges and tapestry. A fair held at the feast of St Bartholomew draws together merchants from different parts of Italy, Germany, and Switzerland.

BERGEN, a sea-port town, and capital of the province of Bergnhuys in Norway, is arranged in the form of a crescent round the head of the bay, is defended on the land side by lofty mountains, and by forts and batteries towards the sea, and contains about 16,000 inhabitants. The harbour of Bergen is reckoned one of the finest in Europe. Timber, fish, hides, and tallow are exported, and corn and foreign merchandize are the principal imports. The public buildings are constructed of stone, but the greater part of the town is built of wood, from which it has been subjected to dreadful calamities by fire. Three terrible conflagrations almost reduced it to ashes in the course of the eighteenth century.

BERGEN, the capital of the island of Rugen, belonging to Swedish Pomerania, stands in the centre of the island; the population exceeds 15,000; and at several fairs, which are held annually, the trade in linen and cattle is considerable.

BERGEN-OP-ZOOM, a beautiful town and strong fortress, stands on a rising ground on the banks of the river Zoom, near its junction with the Scheldt, in the middle of a flat, marshy country, and was formerly one of the frontier towns of Dutch Brabant.

Founded in 1287, by John I. duke of Brabant, when he divided the barony of Breda, it was erected in 1535 into a marquisate by the emperor Charles V. In 1689 it was regularly fortified by the celebrated Cohorn, and has ever since been considered one of the strongest fortresses in Europe. Regarded as a place of great importance, Bergen-op-zoom has been always a point of attack amid the wars and revolutions which have so often distracted that part of the continent. Sieges and battles furnish the chief incidents in its eventful history. In the Dutch revolutionary war, it was the scene of many bloody conflicts; and in 1747 it fell into the hands of the French, owing, it has been alleged, to sudden surprise or secret treachery, rather than to the military skill of the commanders, or signal valour of the troops. But one of the most memorable assaults which Bergen-op-zoom had yet witnessed, took place on the 8th of March 1814, by the British troops under the command of Lord Lynedock. The attack was made at ten o'clock at night; a party of the troops made their way into the centre of the town; but being unsupported by the divisions, which had been retarded in their approach by unforeseen difficulties, they were compelled to lay down their arms, and surrender prisoners of war. The result of so bold and hazardous an exploit, even if it had been successful, could not fail to be disastrous to the assailants. Several officers of rank, and a considerable number of men, fell in the conflict. But it is admitted that the plan of attack was judiciously arranged, and the bravery of the troops in its execution was never surpassed. Bergen-op-zoom is 18 miles north-west from Antwerp.

BERGERAC, a town of the department of Dordogne in France, occupies a fine situation in a plain on the banks of the river Dordogne, by which it is traversed, and contains more than 8000 inhabitants, who are employed in forges, founderies of cannon, and the manufacture of paper in its vicinity. The revocation of the edict of Nantes drove 40,000 protestants in this town and the surrounding territory to seek an asylum in foreign countries, and to enrich other nations by their arts and industry.

BERGMAN, Sir Torbern, an eminent chemical philosopher, was born at Catharineberg, in West Gothland in Sweden, in 1735. In his boyish years he was remarkable, it is said, for a froward, petulant, and mischievous disposition, amusing himself with the destruction of whatever came in his way by committing it to the flames, and delighted with the malicious gratification of seeing the vexation and disappointment of his relations and friends; and neither admonition nor punishment had any influence in restraining this singular propensity. But as he advanced to maturer years, this pernicious habit gave way to serious study and mental improvement. Having completed the elementary part of his education, he entered the university of Upsal in his 17th year, and soon discovered the most devoted attachment to mathematical and physical science. Destined probably by his friends for some department of the active business of life, he was prohibited by the command of a relation with whom he resided to read books of an abstract and profound character, such as *Euclid's Elements*, and *Newton's Principia*. But they were his favourite authors; and seemingly yielding to the injunction, he concealed them from his guardian, devoted the hours of repose to such severe study that his health was injured, and was compelled to relinquish for a time his academical pursuits, and retire to the country.

The restoration of his health in 1754, permitted him to resume his studies at Upsal, on which the splendid reputation of Linnæus at that time threw so bright a lustre. With the example of that great man before them, all those who were ambitious of learned fame, pursued his path, and devoted themselves to some department of natural history. Attracted by these alluring studies, Bergman directed his researches chiefly to insects, and to the progressive changes of their varied existence; and the curious discoveries which rewarded his industry, excited the admiration, and secured to him the esteem and friendship of the illustrious naturalist.

In 1761 he was nominated joint professor of mathematics and natural philosophy. Previously to his appointment he had published memoirs on the *Rainbow*, on the *Origin of Meteors*, and on the *Twilight*; and during the period of five years which he held that chair, he was much occupied in disquisitions on the *aurora borealis*, and other electrical appearances. Astronomy also obtained some share of his attention, for he observed the transit of Venus in the year 1761. The resignation of Wallerius, the celebrated professor of chemistry and mineralogy at Upsal, opened a new path to the ambition of Bergman, and gave a new direction to his pursuits. He appeared as a competitor; but his opponents and their friends started a formidable objection, that he was not qualified by his previous studies to undertake the office. Conscious that the objection was not altogether groundless, with a noble ardour he determined to adopt the best means of removing it; and for this purpose he examined the properties of alum, and drew up a memoir on the subject of its preparation, and the most economical method of procuring that salt. All parties were astonished; his friends hailed it as a triumph and earnest of success, and his adversaries laboured to undervalue its merit. After a severe contest, in which the interference of the prince royal of Sweden, chancellor of the university, was required, Bergman, now in his 32d year, was, with his approbation, appointed to the vacant chair.

Entering with enthusiasm on the duties of his new office, he improved and enlarged the laboratory in the university; disposed in a commodious manner all parts of his chemical apparatus, and the different instruments employed in the arts; re-arranged his own cabinet of minerals along with those of his predecessors; and added the most approved works on chemistry, and the kindred arts, to his collection. The method which Bergman adopted in conducting his researches was peculiarly favourable to the advancement of that science which he was now destined to cultivate and adorn. Dismissing every preconceived theory, he established all his conclusions on accurate observations, and precise results of experiments, judiciously instituted and carefully executed. In all his investigations he was guided by the true principles of inductive philosophy.

The acid property of fixed air was among the first discoveries in the brilliant career of Bergman. To the list of acids he added the oxalic or acid of sugar, which is obtained by the distillation of sugar with nitric acid, the phosphoric, and the molybdic and tungstic, two metallic acids. The earth of barytes, and the characters of some of the other earths were more distinctly discriminated; and in a memoir on crystallization, he derives all the variety of crystals from a simple primitive form. Among the chemical labours of Bergman may be enumerated his excellent analysis of mineral waters, of volcanic products, of precious stones, and of various metallic substances—his ingenious researches into the nature of malleable iron, cast iron, and steel,—and his valuable tables of elective attractions.

The fame of Bergman, which had reached the king of Prussia, the great patron of learning and of learned men, procured for him, in 1776, a pressing invitation from that monarch to fix his residence at Berlin, and to join the celebrated band of literary and scientific characters which adorned his capital. He declined the flattering offer from a grateful feeling of the honours and distinctions which he enjoyed in his own country, although a warmer climate promised to be beneficial to his enfeebled constitution. He had long been afflicted with severe headache and palpitation of the heart. The aggravation of these complaints forced him to relinquish his studies, and in the hope of relief he undertook a journey to Medwi, to have the benefit of the mineral waters; but his strength was exhausted, and he died soon after his arrival in 1784, when he had reached the 50th year of his age. Bergman was not only a member of the academies of his native country, but was admitted into almost all the learned bodies of Europe. To honour his memory the academy of Stockholm ordered a medal to be struck as an expression of regret for the loss which science had sustained by his death; and during his life he had been raised by his sovereign to the dignity of knighthood. The principal works of Bergman,—*his Chemical Essays*,—his *Physical description of the Earth*,—*Essay on the Utility of Chemistry*,—*Thoughts on a Natural System of Minerals*,—*On the Elements of Chemistry*,—and *On the Progress of Chemistry*,—have been translated into French or English, or into both languages.

BERING'S STRAITS. See Beering.

BERKELEY, George, a celebrated metaphysical writer, and bishop of Cloyne in Ireland, was born at Thomastown in the county of Kilkenny in that kingdom, about the year 1684, and was descended from the noble family of Berkeley. The elementary part of his education was conducted at the school of Kilkenny, the same seminary in which Swift, a few years before had been initiated; and in his 15th year he was admitted a student in Trinity college, Dublin, in which he obtained a fellowship in 1707. Berkeley appeared as an author in early life. He had scarcely passed his 20th year, when he published an ingenious essay on *Arithmetic*; and, in 1709, he presented to the world a more celebrated production, under the title of a *New Theory of Vision*, from the consideration of which he concludes that magnitude as it is perceived by the touch, is essentially different from magnitude as it is discovered by the eye. The diversity of result between the notions derived from the senses of touch and sight, it is supposed may have led the ingenious author to adopt the opinion, that the objects of human perception are mere ideas of the mind, altogether independent of material substances. This doctrine was fully developed in his *Principles of Human Knowledge*, in which he denies the existence of every kind of matter, and asserts, that 'all those bodies which compose the mighty frame of the world have not any subsistence without a mind.'

In the year 1712, some of the political sentiments in three sermons which he published, and which had been delivered in the chapel of his college, in support of the doctrine of passive obedience, brought against him a charge of Jacobitism, and for a time retarded his preferment. But he had the good fortune afterwards to obtain the patronage of the prince and princess of Wales, who succeeded to the throne as George II. and queen Caroline. About the same time he produced another work, *Three Dialogues*, &c. in defence of his doctrine of Immaterialism, and through the good offices of his countrymen, Dr Swift and Sir Richard Steele, he became the associate of Addison, Arbuthnot, and Pope, and formed one of that bright constellation of men of genius which then adorned English literature. He was a contributor to the Spectator and Guardian.

In 1713, Dr Berkeley accompanied the Earl of Peterborough, in the capacity of chaplain and private secretary, on an embassy to Sicily and Italy; and on his return to England in the succeeding year he undertook a more extensive tour through Europe. After various disappointments he was nominated to the deanery of Derry in 1724; and about the same time the death of Mrs Vanhomrigh, the celebrated and unfortunate Vanessa of Swift, left him in possession of the unexpected bequest of one half of her property, amounting to L.4000, for which he seems to have been indebted to his agreeable manners and distinguished character, for it is said that he had been only once in her company.

The benevolent scheme of converting the American Indians to Christianity, by erecting a college in Bermudas for supplying the churches in the plantations with proper teachers, had for some time occupied the mind of Dean Berkeley; and in 1725 he published his plan in London, and offered to resign his rich benefice, and to accept of the moderate annual salary of L. 100. Three junior fellows of Trinity college, Dublin, eager to second his noble and disinterested efforts, declared their willingness to resign their livings and to accept of L.40 a-year. The plan of the institution was at last approved of; a charter was granted for erecting a seminary, to be called St Paul's college, in Bermudas, and to be composed of a president and nine fellows, who were bound to maintain and educate Indian children at L.10 a-year; and for the establishment and support of the institution L.20,000 were voted, and one-half of the sum was immediately advanced. The dean and his associates, who were permitted to retain their livings in Ireland till the whole sum was paid, crossed the Atlantic and arrived at Newport in Rhode Island, contracted for the purchase of lands on the contiguous continent, and, after many tedious delays and much fruitless expectation, the remaining L.10,000 was never paid; and, after seven years of his life spent in promoting the establishment, with a considerable diminution of his private fortune, he was compelled to return to Europe mortified and disappointed at his failure.

In 1732 the *Minute Philosopher*, one of his most popular and most admired productions appeared. The object of this work, which is drawn up in the form of dialogue, is to refute the tenets of a free-thinker, who is represented in the various characters of atheist, libertine, enthusiast, sceptic, &c. At the recommendation of queen Caroline, whose favour he still retained, he was preferred to the see of Cloyne, and was consecrated bishop in 1734, on which occasion he declared that he would never accept a translation, and to this resolution he firmly adhered, even when the offer of a more valuable benefice was in his power. He resided constantly in his diocese, where he was distinguished by pastoral vigilance and hospitality; and by promoting at once the temporal and spiritual welfare of all ranks, greatly endeared himself to his flock. While his health permitted he preached regularly, and his sermons were always extemporaneous.

Besides some philosophical disquisitions connected with his former inquiries, bishop Berkeley published some works on municipal and prevailing political subjects of the day; and it is not a little to his praise, that in consequence of a letter addressed, in 1749, to the Roman Catholic clergy of Ireland, he received the thanks of that body, by whom he was characterised as " the good man, the polite gentleman, and the true patriot." His *Siris*, a treatise on the virtues of tar-water, became a popular work, and was the means of introducing that substance as a kind of universal remedy.

In 1752 he determined to retire with his family to Oxford, to superintend the education of his son; but as he was strongly impressed with the obligation of residence in his diocese, he endeavoured to exchange his bishopric for some benefice in Oxford. Failing in this plan, he applied to the secretary of state for permission to resign his bishopric; but the king declared, when the petition was presented, that he would not accept the resignation, and that the bishop had full liberty to choose his own residence. Before his departure from Ireland, he directed an income of L.200 a-year from some part of his lands to be distributed among the poor. His residence at Oxford was of short duration. On Sunday evening the 14th January 1753, while one of his family was reading a sermon of Dr Sherlock's, he expired in a moment without a groan or convulsive pang. The fine eulogium of bishop Atterbury, after the first conversation with this excellent prelate, " so much understanding, so much knowledge, so much innocence, and such humility, I did not think had been the portion of any but angels, till I saw this gentleman"--and the high encomium of Pope, who ascribes

"To Berkeley every virtue under heaven,"

shew in what estimation his character was held by his cotemporaries; and the details of his life, with the perusal of his works, will enable posterity to judge of the talents of the philosopher and the virtues of the man.

BERKSHIRE, an inland county of England, has the Thames and Oxfordshire for its boundary on the north, Buckinghamshire on the east, Surrey and Hampshire on the south, and Wiltshire on the west, and includes an area of nearly 780 square miles, or more than 476,000 acres. Berkshire admits of four natural divisions, 1. The White-horse Vale, which is bounded on one side by the Thames and on the other by the White-horse hills, a ridge of elevated land, which is a continuation of the Chiltern range, 2. The Chalk-hills, which traverse the lower part of the county: 3. The vale of Kennet; and, 4. The Forest division, which stretches across the country from the east of the river Loddon to Old Windsor.

The solid strata of Berkshire are composed of chalk, which abounds with animal remains; extensive beds of sand and gravel are common in many places; a coarse kind of fuller's earth is sometimes met with, and pipe and potters' clay is dug out for the manufacturer. The peat-earth of Berkshire, in which gypsum predominates, has been celebrated as an active manure when converted into ashes. The prevailing soil is a calcareous loam; in some places it is gravelly, but is generally fertile and productive. In the southern parts of the county the gravel and clay soil is remarkable for its sterility.

The Thames, which is a natural boundary to Berkshire for more than 100 miles, the Kennet, the Loddon, the Ocke, the Lambourn, and the Auborn, are the principal rivers, and some of them abound with excellent fish. Berkshire has the advantage of inland navigation from the Wiltshire and Berkshire canal, and the Kennet and Avon canal, which latter is carried from Newbury to Bath, a distance of 60 miles.

The population of Berkshire was estimated, in 1700, at 75,000; in 1801 at 109,215; and in 1811 at 118,277. The chief towns are Abingdon, Reading, which are both considered as county towns, Farringdon, Hungerford, Ilsley, Lambourn, Maidenhead, Newbury, Oakingham, Wallingford, Wantage, and Windsor. Wheat and barley are the chief corn crops of this county. A great deal of malt is manufactured for the supply of the London and Bristol market. Some extensive farms are laid out for the production of the dairy. Cheeses in the form of the pine-apple are highly celebrated for their fine flavour, and bring a superior price in the market. Numerous flocks of sheep are reared on the hilly pastures, and the excellence of its breed of hogs is well known. A considerable extent of the surface of this county is covered with woods; but the banks of the Thames, the vale of Kennet, and Windsor forest, are chiefly remarkable for forest timber.

The manufacture of cloth, which flourished in some of the towns of Berkshire in the 17th century, is now unknown. Beside two paper-mills, one of which is on a large scale, the manufacture of serge at Newbury and of coarse sacking at Abingdon only merits notice. The rolling and hammering of copper for bolts and sheathing for ships, as well as for foreign trade and domestic purposes, at the Temple-mills, form an extensive concern, in which 1000 tons of copper have been sometimes manufactured annually.

BERLIN, the capital of Brandenburgh, and of the Prussian dominions, is one of the finest towns of Germany, stands on the banks of the Spree, which falls into the Havel, a tributary stream of the Elbe, and is more than four miles long and three miles broad. The streets are generally regular and broad; several of them exceed a mile, and Frederick Street is more than two miles in length, and the houses are constructed with freestone or brick, and are usually two stories in height. The squares are spacious, and many of the public buildings are magnificent edifices; among which are enumerated the royal palace, which is four stories high, has some of the apartments adorned with the richest tapestry, and many pieces of furniture of solid silver, and includes a library of 100,000 volumes, of which number 500 bibles, and among them, it is said, is the bible which Charles I. of England used when he was brought to the scaffold; the arsenal, which is one of the grandest structures of the kind in Europe, is adorned with a statue of Frederick I. which is greatly admired; and the royal stables, which are equally spacious and magnificent, have two courts with a covered menage between them.

Berlin is also adorned with other splendid edifices, such as the opera-house, the hall of the academy of sciences; the hospital of invalids, in which 1000 officers and soldiers are lodged and maintained; various palaces and numerous churches. Some of the bridges over the Spree, and some of the large squares are adorned with splendid statues of bronze or marble. The neighbourhood of the city is finely diversified with canals, vineyards, and beautiful villas; and the parks, which are agreeable places of resort, are much frequented on Sundays and holidays. The institutions for the cultivation of literature and science, or destined to charitable purposes, are numerous.

The population of Berlin, including the garrison, which amounts to about 30,000, is estimated at 140,000. The manufacture of silk, woollen, cotton, and linen cloth is extensive; in 1799, 7014 looms were employed, and the whole number of artisans exceeded 14,000.

BERMUDAS, or SOMER ISLANDS, a group of islands in the Atlantic ocean, in north latitude 32° 35′, and between two and three hundred leagues from the continent of America. The whole number of these islands is about 400, extending over a space of 45, miles from north-east to south-west; but most of them are bare rocks, and very few are inhabited. Their discovery was accidentally made in 1527, by John Bermudas, a Spanish navigator, from whom one of the names is derived; but he neither landed, nor was any settlement made by his countrymen. Soon after, Henry May, an Englishman, was unfortunately shipwrecked on one of the larger islands; and having constructed a vessel of cedar-wood, an abundant production of these islands, he returned to Europe, and published an account of them, the first which had appeared. In 1609, Sir George Somers and some others, in a voyage to Virginia, as deputy-governors, had also the misfortune to be shipwrecked on the Bermudas. They reached America in vessels built of the native cedar-wood; and Sir George having returned to the islands in search of provisions for the colony in Virginia, died soon after his arrival, and from him they were denominated, Somers, or Summer's islands. His surviving companions returned to England; made a favourable report of their beauty and fertility; and induced the Virginia company, who claimed the property, to divide the whole into 120 shares, and to assign the right to the purchasers, who obtained a charter from James I. An expedition was fitted out in 1612; and 60 planters proceeded as adventurers, under a regular form of government, to form a settlement. In the course of a few years the Bermudas were crowded with inhabitants from England; some attracted by the exaggerated accounts of the fine climate, and some driven from their native country by the distractions and dangers which prevailed during the civil wars.

The principal islands are, Bermuda, Saint George, Saint David, and Somerset. Bermuda exceeds 30 miles in length, and is about two in breadth. The country is generally rugged and mountainous, but in many places the plains are covered with a fertile and productive soil. The Bermudas are divided into nine parishes, which include more than 12,000 acres. The white inhabitants in 1810 were estimated at 4755; the free persons of colour at 451, and the slaves at 4794, making the total population equal to 10,000; but it is supposed that the number of black and coloured inhabitants is under-rated. The government is similar to that of the West India colonies. The established form of religion is that of the church of England; but there is a presbyterian congregation, and another belonging to the methodists, which are supported by voluntary contributions.

Indian corn, tobacco, and a little cotton, are the chief vegetable productions which are objects of culture; and most of the West India fruits grow to perfection. Turtle is abundant on the coast, and is a valuable source of trade; and ambergris, of which large masses were collected by the early settlers, who entertained sanguine hopes that it would be a permanent acquisition, is occasionally met with in small quantities. Beside agricultural occupations, the inhabitants are employed in ship-building of native cedar-wood, in fishing, and in carrying salt from Turks island to America.

BERN, one of the largest cantons of Switzerland, is bounded on the east by the cantons of Uri, Underwalden, and Lucern; on the south by the lake of Geneva and the duchy of Savoy; on the west by Soleure and part of France; and on the north by Basle and the Austrian forest-towns. The length is estimated at 180 miles, and the breadth about 90 miles. The canton of Bern presents an extremely diversified surface; it is encompassed with lofty mountainous groups; and its extensive forests and spacious lakes exhibit altogether a great variety of picturesque scenery.

The population of the canton is variously estimated at 340,000 and 400,000, distributed in a number of considerable towns and many small villages. The plains are fertile and well cultivated, and the elevated regions afford excellent pasture to numerous herds of cattle. The manufactures of linen, woollen, silk, and cotton-stuffs, and coloured stockings are considerable; and, with cheese, butter, and horses, afford a valuable trade with the neighbouring districts.

BERN, the capital of the canton of the same name in Switzerland, stands on the banks of the Aar, and is nearly encompassed by that river. The streets are spacious and clean, the houses are nearly of the same height and uniformly built, and the town is adorned and refreshed by fountains, which are supplied with water from a branch of the Aar. The cathedral is a fine Gothic structure, which has been much admired. The population of Bern is estimated at 15,000, who are chiefly occupied in the manufactures already noticed in the description of the canton. Bern can boast of a number of literary and scientific institutions. It is 45 miles south from Basle, and 78 miles north-east from Geneva.

BERNERA, a small island belonging to the western islands of Scotland. See HEBRIDES.

BERNOULLI, JAMES, a celebrated mathematician, was the son of Nicholas Bernoulli, an active and respectable citizen of Basle, who held important offices in his native city, and was born at Basle in 1654. Nicholas Bernoulli left a family of eleven children; two of whom, James and John, distinguished themselves by the most profound geometrical investigations, and rose to the highest rank among the mathematicians of the eighteenth century.

James Bernoulli was destined for the clerical profession; but his strong inclination for mathematical studies withdrew his attention from every other pursuit, and he gave very early proofs of talents for those profound investigations by which he was afterwards so distinguished. Having visited different countries of Europe, he was elected professor of mathematics at Heidelberg; and at the end of three years was appointed to the same chair in the university of his native city. He died in 1705, when he had reached the 51st year of his age.

BERNOULLI, JOHN, a distinguished mathematician, was the tenth son of Nicholas Bernoulli, and was born at Basle in 1667. The early part of his education was conducted, first, with a view to commercial pursuits, and afterwards to qualify him for the practice of medicine. But with the example, and under the tuition of his brother James, his studies were directed to mathematical science, in which he acquired the highest reputation. He was first appointed professor of experimental philosophy in the university of Groningen; and, on the death of his brother, succeeded to the professorship of mathematics at Basle. He died in 1748, in the 81st year of his age. Of a family of nine children, three were professors; and Daniel, in mathematical genius, was not surpassed by his father and uncle.

BERNOULLI, DANIEL, a very eminent mathematician and natural philosopher, was the son of John Bernoulli, and was born at Groningen in the year 1700. He began early the study of mathematics, and gave unequivocal proofs of powerful talents in geometrical investigations. He prosecuted the study of medicine, first in his own country, and afterwards in Italy; but still mathematical pursuits occupied a large share of his attention. Being invited by the academy of St Petersburgh, he repaired to that city; and, greatly honoured and distinguished, he spent several years of his life in the imperial capital, till his declining health required him to seek for its restoration in a milder climate. In 1733 he returned to Basle, which was then his father's residence, and was elected professor of medicine and afterwards of physics. He died in 1782, in the 83d year of his age.

The sublime genius for mathematics which pervaded this remarkable family, presents a prominent feature in the history of the science. A minute detail of the profound researches and sublime investigations with which they were occupied, could not be interesting to the general reader. But the jealousy and rivalship which existed between the two brothers, and between the father and son, exhibit another feature in their lives less amiable but not less singular. Ambition for fame diminished the warmth of affection which had subsisted between the two brothers before they had acquired such distinguished reputation; and a difference of opinion, about the solution of a mathematical problem, burst asunder the bands of friendship, and produced the most decided enmity. John Bernoulli entertained the same jealousy against his son Daniel. The first efforts of his youthful genius in the brilliant career which he was destined to run, were rudely repressed; and when he divided the prize with his father, for the best explanation of the variation in the inclination of the planetary orbits, the mortification of the latter was extreme, and terminated in bitter resentment and permanent hostility.

BERWICK, COUNTY, or Berwickshire, forms the south-eastern portion of Scotland; has the river Tweed for its boundary on the south, the German ocean on the east, East-Lothian on the north, and on the west Mid-Lothian and Roxburghshire, and is about 30 miles long, and about 19 miles at its greatest breadth. Berwickshire is traversed at its northern extremity by a lofty ridge, the Lammermoor mountains, which, stretching westward from the promontory of St Abb's head on the east coast, preserves an elevation of nearly 1000 feet, and in one place rises 1500 feet above the level of the sea. The prevailing rocks are, the grey wacken of mineralogists; and of the schistose variety, which is also met with, some is dug out for the purpose of roof-slate. Extensive beds of red sandstone skirt the eastern coast of the county; and a large mass of breccia, or plumb-pudding rock, constitutes the northern promontory of Eyemouth-bay. The Tweed winds its majestic stream along the margin of Berwickshire for a course of forty miles; but within its borders, the Whitadder and Blackadder, which mix their united waters with the Tweed near Berwick, and the Leader and the Eden, of inferior magnitude, are the principal rivers.

The population of Berwickshire, which in 1755 was estimated at nearly 25,000, amounted in 1801 to 30,621, and in 1811 to 30,779. Greenlaw the county town, and Dunse, with a population exceeding 3000, Coldstream, Lauder, and Eyemouth, are the chief towns. The manufacture of paper, the salmon fishery on the Tweed, the white fisheries on the east coast for the supply of the Edinburgh market, and the export trade from Eyemouth, with the importation of coal, lime, and other commodities for domestic consumption, beside the labours of agriculture, afford the principal employment to the inhabitants. The modern agricultural improvements in Scotland were first introduced into Berwickshire, which still takes the lead in the most approved system of alternate husbandry. The elevated districts of the Lammermoor hills afford excellent pasture to numerous flocks of sheep.

BERWICK-UPON-TWEED, stands on the northern bank of that river, about a mile from its influx into the German ocean; from its peculiar position was often a disputed post between the rival nations of England and Scotland, but is now annexed to England, with a small territory of four or 5000 acres, and is governed by English laws. Berwick was fortified by the English early in the sixteenth century; and the remains of fortifications of a still older date, erected by the Scotch, are still visible. Few of the streets are spacious; some of them are steep and narrow; and the bridge of sixteen arches, which crosses the Tweed, and can lay claim to some antiquity, is also narrow and incommodious.

The population, which in 1801 was estimated at 7187, had increased, in 1811, to 7746. The municipal establishment is assimilated to that of English boroughs. The Tweed is navigable to the town; but a bar at its mouth excludes vessels of large burden. Timber, iron, and flax are imported from the Baltic; grain, in considerable quantities, from the neighbouring districts, and wool, and eggs, and salmon preserved in ice, for the London market, are exported. It is said that L.20,000 worth of eggs have been shipped off in a single year. The rent of the salmon fishery exceeds L.10,000 annually. Berwick is 54 miles from Edinburgh, and 335 from London.

BERWICK, NORTH, a royal borough and seaport town of the county of Haddington, or East-Lothian, in Scotland. The harbour admits small vessels, and some grain is exported. The population is about 1600. The ruins of the castle of Tantallon, the ancient residence of the powerful family of Douglas, form a striking object, on a precipitous rock, washed by the sea, two miles from the town; and North Berwick-law, in its immediate vicinity, is a conspicuous land-mark, and rises in a conical form to the height of 800 feet.

BERYL, a mineral substance ranked among precious stones, and belonging to the siliceous genus. See Mineralogy.

BESANCON, the capital of the department of Doubs in France, stands on the banks of the river which gives name to the department, and traverses the city. The town is walled, fortified, and well defended by a strong citadel. The houses are well-built of stone, the streets are long and spacious, and the churches and public buildings are fine structures. Numerous remains of Roman antiquity are still visible in the ruins of a triumphal arch and some other buildings. Encompassed with mountains, the vicinity of Besançon exhibits many picturesque scenes, and the warm baths near the town offer a luxurious enjoyment to the inhabitants. The population is between 20,000 and 30,000; and fire-arms, swords, and clocks are the principal manufactures.

BESSARABIA, a province of the Ottoman empire, which is bounded on the east by the Black sea and part of the Russian territory, on the south by the Danube, and on the north and west by Moldavia; in some places is extremely fertile, producing grain, hemp, and flax, and is celebrated for the excellence of its fruits and the superior quality of its wines. The salt obtained by spontaneous evaporation of the waters of some lakes in this province, furnishes a valuable commercial commodity, and affords a considerable revenue to the government.

BETA, the Beet, a genus of plants belonging to the Pentandria class.

BETEL, the *Piper betle* of Linnæus, is a native of India, and is extensively employed in eastern countries as a luxury.

BETHESDA, a pond or public bath near the sheep market in Jerusalem, which was famous for the cure of the diseases of those who bathed in its waters. According to the Scriptural account, an "angel went down at a certain season into the pool and troubled the water: whosoever then first after the troubling of the water stepped in, was made whole of whatsoever disease he had." On the subject of this pool much disquisition has been employed by divines and commentators; but it seems to be generally admitted, that the cures which were performed by it in the time of Jesus Christ, are to be ascribed to miraculous influence.

BETHLEHEM, a city of Palestine, which is famous as the birth-place of Jesus Christ; and because it was also the birth-place of David, king of Israel, it was called the city of David. The place is now reduced to the state of a village, but it has been adorned with religious houses and magnificent churches, and has long been the annual resort of numerous bands of pilgrims, who come from distant quarters to perform their devotions. The village of Bethlehem is seated on an eminence in a mountainous district, and is two leagues south-east from Jerusalem. Fruits, olives, and vines thrive well, and, from the latter a white-wine, which has obtained some celebrity, is obtained.

BETHUNE, Maximilian, de, Duke of Sully, a celebrated French general and politician, was born in 1560; entered in early life into the service of the king of Navarre, afterwards Henry IV. of France, and rose to the highest and most important offices in the state. In war, in finance, and in negotiation, Sully was always distinguished by prudence, vigour, and fidelity; for his eminent services he received the most substantial benefits, and was honoured with the most splendid distinctions; and it is not a little remarkable, that he enjoyed all this influence and power while he professed through life the reformed religion, although, from motives of conciliating contending factions, he recommended to his master, who had been also a Protestant, to embrace the Catholic faith. But his zeal and integrity in the management of public affairs were not equally appreciated by the successor of Henry; for on the assassination of that prince, in 1610, he withdrew from court into the retirement of private life, and died in 1641, when he had reached the 82d year of his age. The *Memoirs of Sully* is a well known popular work, of which an English translation has been long before the public, and contains a highly interesting narrative of French history for a period of 40 years, from 1570 to the death of Henry IV.

BETONICA, Betony, a genus of plants belonging to the Didynamia class.

BETULA, the birch-tree, a genus of plants belonging to the Monœcia class.

BEVERLEY, a town in Yorkshire in England, which contains more than 5000 inhabitants, has a considerable trade in malt and manufacture of leather, and is remarkable for its spacious market-place, which is adorned with a fine cross. The minster is an elegant edifice, decorated with monuments in commemoration of the noble family of Percy.

BEVIEUX, a village of Switzerland, which is famous for the salt springs in its vicinity. The rocks of which the mountains are composed, and from which the springs have their source, are a whitish gypsum, mixed with blue clay, impregnated with salt. The operations are conducted by shafts, galleries, and machinery for raising the brine to reservoirs on the surface. It is said that these salt-works yield an annual profit of L.3000. Bevieux is three miles distant from Aigle.

BEWDLY, a town of Worcestershire in England, derives its name from the French *Beaulieu*, signifying *beautiful place*, it is conjectured, from its charming situation on a declivity on the banks of the Severn; contains nearly 4000 inhabitants, who are engaged in the manufacture of malt and leather, and particularly for caps known by the name of Monmouth caps, and enjoys a considerable trade by means of the Severn.

BEY, or BEGH, the appellation of a Turkish governor of a province or city. Some of these officers, as the bey of Tunis, have, by power or usage, acquired sovereign authority, and their dependence on the Ottoman Porte is little more than nominal.

BEZIERS, a city of the department of Herault, in France, occupies a fine situation near the junction of the river Orbe with the great south canal; contains more than 14,000 inhabitants, who are engaged in the manufacture of cloth, silk stuffs, and brandy, and is celebrated for the remains of a Roman amphitheatre. The university of this place was established in the end of the 16th century.

BEZOAR, a peculiar concretion which is formed in the stomachs of animals of the antelope and goat kind, and was once famous as a remedy in many diseases. The name is derived from a Persian word, signifying *antidote against poison*, because it was also employed for that purpose. Bezoar stones were at one time in such high repute as to find a place in the list of medicines recommended by the colleges. But the nature of the substance, which modern chemistry furnishes the means of examining, shews that the effects were exaggerated, so that they are now neglected. The formation of the Bezoar in the stomach of the animal depends on a nucleus of straw, hair, the pod of a fruit, or some indigestible substance, round which concentric layers of secreted matter are deposited.

BHADRINATH, a small town and celebrated temple in the province of Serinagur, in the northern regions of Hindostan, which stands in a valley in north latitude 30° 43′. The town includes only twenty or thirty huts for the accommodation of the brahmins during their visit in the time of the annual pilgrimage. The sacred temple, to which a supernatural origin is ascribed, rises in the form of a cone, with a small cupola, surmounted by a copper roof, a golden, or gilt ball, and spire, to the height of forty or fifty feet; the idol, three feet high, cut in black stone or marble, is richly dressed in gold and silver brocade; and in such veneration is this establishment held that it can number 700 villages among its possessions. But the offerings of pilgrims constitute a copious source of its revenue. A hot spring issues from the adjoining mountain, and supplies a warm bath; to numerous cold springs in the vicinity appropriate names and peculiar virtues are assigned, and from them, as his needs require, the pious visitant derives purification and comfort. The pilgrims are estimated annually at 50,000, and the greater proportion is composed of *fakirs*, or devotees, from the remotest corners of India. They assemble at the great fair of Hurdwar, and at its conclusion depart to the far-famed shrine. In the end of May 1808, masses of snow, 70 feet thick, were observed on the road to Bhadrinath, and the summits of the higher mountains are covered with perennial snow; a striking proof of the great elevation of a region in the 30th degree of latitude.

BIAFARA, a district of Africa, which is bounded on the south by the Rio Grande, and is included between the 11th and 12th degrees of north latitude. The inhabitants of this country are described as a peaceable inoffensive race, and from their chiefs, captain Beaver, who made an attempt a few years ago to establish a settlement on Bulama, obtained a grant of that island, of which some account may be seen in his *African Memoranda.*

BIBLE, from the Greek, and signifying *book*, is applied as a distinctive appellation to the scriptures of the Old and New Testament. See *Scriptures*, under RELIGION.

BIDEFORD, a seaport town of Devonshire in England, is a neat clean town, has a good harbour, which admits large vessels to the quay in its centre, a population of 3000, has a considerable concern in the Newfoundland fisheries, not fewer than 100 vessels of various sizes in the carrying trade, and exports oak timber and oak bark to Scotland and Ireland. The manufacture of earthen-ware, which is transported to Wales, is extensive.

BIDENS, WATER-HEMP AGRIMONY, a genus of plants belonging to the Syngenesia class.

BIENNE, formerly the capital of a district of the same name in Switzerland, and included at the French revolution in the department of the Upper Rhine, stands at the foot of mount Jura on the banks of the lake Bienne; has some manufactures of leather and printed cloths, and is remarkable for its abundant supply of water from numerous public fountains. The lake of Bienne is nine miles in length and two miles in breadth; the shores are adorned with castles, villages, and picturesque scenery; the island of Saint Peter, clothed with stately oaks, beeches, and chesnuts, is famous for a two months residence of the celebrated Rousseau, and is still the resort of strangers, particularly in the vintage season.

BIGGLESWADE, a town of Bedfordshire in England, occupies a fine situation in a valley on the banks of the Ivel, which is navigable at this place. is famous for its market for grain and pease, and has a population exceeding 1600, with a small manufactory of thread-lace.

BIGNONIA, TRUMPET-FLOWER, or SCARLET JASMINE, a genus of plants belonging to the Didynamia class.

BIJUGA, or BISSAGOS ISLANDS, a group of islands, of which thirteen are said to be inhabited, on the south-western coast of Africa, and separated from the continent by a deep channel, which stretches towards the island of Bulama, a course of more than 100 miles, and many of them are fertile and well wooded. Rice and fruits are produced in abundance. The natives are not more civilized than their continental neighbours; they are represented as treacherous and cruel; fond of war, no doubt for the sake of plunder; and bold and intrepid in enterprize. Beaver's *African Memoranda.*

BILBOA, the capital of Biscay in Spain, is situated on the bay of Biscay; the houses are lofty and well built; the streets are paved and clean; it is accommodated with docks for ship-building; and the promenade on the banks of the river, shaded with oaks and lime-trees, and bordered with warehouses and gardens, is highly celebrated. The population is about 15,000; and the trade with the mercantile countries of Europe is considerable.

BILE, a yellowish, bitter liquid, which is secreted in the liver, and seems destined to promote the digestion or assimilation of the food in the animal economy. See ANATOMY.

BILEDULGERID, *the Country of Dates*, or, by some, the *Dry Country*, a region in the northern quarter of Africa, which is included between the states of Barbary and Sahara, or the Desert. The interpretation of the name is characteristic of the climate, or of the productions of the country. The natives are Arabs, who profess Mahometanism; they are occasionally employed as mercenary troops by the neighbouring states; but they are oftener engaged in plundering excursions, or in hunting the ostrich, the flesh of which serves for food, and the feathers are a valuable commercial commodity. The fruit of the date, with a little dried fish, and camels milk and goat's flesh, constitute their ordinary fare.

BILL, a term of very general application; as, in commercial affairs, a bill of *lading* or of *exchange;* in law, a declaration in writing of some complaint or grievance; and in parliament, certain propositions which are offered for consideration, and, if approved, to be passed into a law.

BILLIARDS, from a French word signifying *ball*, a game which was invented by the French, and is played with ivory balls. See GAMES.

BILSTON, a town of Staffordshire in England, which is celebrated for its manufactures of japanned

Biography. and enamelled wares, and the numerous smelting furnaces, forges, and mills, for the reduction of the ores of iron, and for its conversion into various implements and utensils. The population is about 7000; and by means of inland navigation the communication with most parts of England is greatly facilitated.

BIOGRAPHY, is a species of literary composition which relates the actions and fortunes, and describes the characters of remarkable individuals. The term is derived from two Greek words, signifying *to write*, and *life*, and is properly used in contradistinction to history, the object of which is to record the origin, progress, revolutions, decline, and fall of states and countries.

As a nation is merely an aggregate of mankind on a larger scale than a family, and is no less liable to be influenced by the personal qualities and behaviour of its members, biographical sketches are necessarily blended in the narrative of events, and even with the discussion as to their causes, in which it is the duty of the historian to engage. Thus, it cannot be doubted, that the ambition of a Cæsar, or a Bonaparte, the patriotism of a Brutus, or the moderation of a Washington, the licentiousness of our Henry VIII. the hypocrisy of Cromwell, and the bigotry of the second James, materially affected the fortunes of their countries, and are consequently entitled to duly proportioned notice in the memoirs of their times. Biography, then, is, in this respect, obviously subservient to history, and indeed very often forms its chief interest and utility. Much there is, undoubtedly, to demand attention and exercise thought, in the progress of large masses of our species, from the savageness of the desert to the refinement and policy of civilized life, and through all the eventful periods of their prosperity, decay, and ruin. The miseries of their early condition,—the struggle between necessity and intelligence, by which our nature has been so much exalted,—the gradual accumulation of arts and devices, which enriched every present generation beyond the narrow conceptions of the preceding,—those new trials and perplexities, in which success itself so often involved the rising community, and which, by calling forth the evil principles of human nature, almost certainly prepared the means of its dissolution,—above all things, those repeated appeals to brutal force, and malignant or cruel inventions, by which the imperfections of all worldly policy are so dreadfully disclosed,—these events it is utterly impossible to contemplate with indifference, because, in addition to their magnitude and duration, by which they are calculated to occupy the imagination, they involve consequences, and suggest analogies, of importance to our own circumstances and conditions. But this reasoning and calculating spirit, on the whole, is little operative on the feelings. A reader finds some solace in the disproportion which he bears to the numbers concerned, and still more in the absence of all claim on personal sympathy. The prosperity and the sufferings of a large nation, more especially one which has long ceased to act its part on the theatre of the world, are to him merely abstract ideas, which have neither prototype nor foundation in his affections, and which he can readily, and almost at will, combine with any arrangement of causes which the information and skill of the historian authorise. As far as mere feeling is concerned, accordingly, he admits with equal facility the loss of twenty and of thirty thousand men in any celebrated battle, and cares not whether such a catastrophe occurred on the banks of the Euphrates or in the plains of Thessaly. In reality, he possesses no internal criterion of probability by which such extensive operations can be measured, and cannot experience a thousandth part of the emotions, sentiments, and prejudices which occasioned them, or operated during their continuance. Biography.

This puny effect of such relations, even in the hands of the greatest masters in historical composition, gives the lie to that universal philanthropy which it has sometimes been so much the fashion to admire, and demonstrates the actual selfishness and confined solicitudes of the human heart; and sufficient reasons are not wanting to palliate, if not to justify, this comparative apathy. What profitable dictate, what salutary result, it may be asked, can accrue to a private individual, at least, from the most authentic records of national affairs, beyond the gratification of rational curiosity, or the conviction which he can easily obtain elsewhere, or realize in his own experience, that uncertainty, vicissitude, and sorrow are by much the most considerable portion of human life, and that the gleams of comfort and happiness by which they are so sparingly checquered, give them but the greater power of afflicting? The knowledge thus acquired may enhance his consequence as a man of learning, and furnish topics on which the powers of description and the stores of memory may be displayed with enviable eloquence; but it is almost totally unproductive of any prudential rules by which he shall be enabled to avoid the calamities of the world, or any valuable remedy by which he can overcome them. To the politician, indeed, the study of history holds out some indipensable advantages. It is there he can safely learn the fallaciousness of prosperous appearances, the vanity of narrow expedients and temporising compliances, the hazard of despising, neglecting, and thwarting popular prejudices, and the certainty of mischief as the consequence of goading the passions beyond the well ascertained limits of practicable endurance. He may perceive by it the imperious necessity and the benefits of husbanding the national resources, and securing popular opinion, against a time when both shall be required in defence of the vital interests of the state; it may furnish him with the habit of discriminating between the imperishable laws of society, and the accidental and trivial institutions by which communities are often for a short time united; it may yield him, in short, or, more properly speaking, it may aid and foster the capability of managing public affairs, by furnishing precedents and inductive conclusions; though, after all, it be questionable, whether the process be likely to augment respect for his species, or to render him more indulgent and sympathising to its weaknesses and misfortunes.

The labours of the professed biographer, and even the occasional portraits which the historian is so often induced to delineate, are more level to ordinary conceptions and interests, and may be more easily appreciated by personal observation. The life of an individual, however exalted above our own station, and however different the circumstances in which he was placed, is nevertheless in many respects a transcript of one's self. He had the insignificance and the fretfulness of infancy, and the waywardness and impatience of youth,—he projected schemes of felicity, and was disappointed,—he trusted appearances, and was deceived,—resolved to be wiser in future, but surrendered his invincible judgment to the next gay vision which flitted across his fancy,—the necessity for exertion, either to procure a livelihood, or to gratify his ambition, was accompanied by feverish anxiety, and followed by desponding indolence,—perhaps he gave 'hostages to fortune,' married and had children, so multiplied the points on which his little comfort might be assailed, for the uncertain chance of an additional share of happiness,—he had his embarrassments and gloomy days, or if sunshine beamed on his toils and flattered his hopes, it gendered also the caterpillar and viper that envied and marred his prosperity,—the cup of joy which he had been anxiously endeavouring to fill, by years of self-denial and industry, never reaches his lips, or falls from them at the very moment of tasting,—pain, and sickness, and languor, render him burdensome to himself, and are but preludes to that closing event, which is only one of the many affecting scenes in which it shall certainly be our lot to resemble him. Such may be the general causes of that high interest which most persons take in biography. There are many additional reasons for it, though of rather more partial application. Some of these point out the sort of utility of which it may be instrumental.

The person whose life is recorded must have been somewhat remarkable for talents, for actions, for character, attainments, or fortunes. Millions of mankind pass through the world without attracting a single eye beyond the narrow circle of their families. They breathe, and sigh, and struggle, rejoice and lament, in their primitive obscurity, unheeded and unknown, quietly and usefully it may be, filling up the vacuities of society, and ministering to the common wants of their fellow creatures. These are not the proper subjects for biography. Even the zeal of ardent friendship, and the affection of kindred, have rarely brought forward an individual to the public gaze who had not been previously signalized by endowment, or qualification, or conduct. It is only the eminent poet, the painter or musician, the philosopher, the soldier, or statesman, the man of genius who has created a world around him, or whose productions and deeds have blazoned the time and place in which he lived, that can justify the distinctions of literature, or furnish materials for its labour. Of such persons, it is equally important and curious to know much more than can ordinarily be learned from their works. A man of this kind is less a private individual than 'a child of the state,' and is necessarily exposed to public scrutiny, and even the inquiries of posterity, to whom he answers the purpose of a land-mark, and evidence of a former world.

Great reputations are rare—the excellence which can compel them is still rarer. How have they been obtained? What was the concurrence of circumstances, or whence the power whose agency has perpetuated the names of illustrious men beyond the vulgar notoriety of their age and country? In what manner was that hand trained which so exquisitely spread existence, and intelligence, and feeling, on the unmeaning canvass? Where was the eye enriched, beyond the ordinary blessings of vision, whence emanated those interesting groups which people the landscape,—yon peaceful hamlet, with its during bowers, and greensward enclosure, and busied animation,—yon sloped and softened bank, where the mouldered turret projects its rugged shadow on the sunbeam's glare, defying the farther ravages of time,—yon azure expanse, so gently fringed with woolly clouds, and indented with the beech tree's straggling branches? What elementary harmonies suggested to Handel the ideas of his seraphic commentaries? What calamities urged, and were soothed by the thrilling melodies of a Mozart? What amplitude of soul broke forth in the symphonies of a Haydn? Did the fervour of Milton's muse diffuse warmth through his youthful poetry, or suddenly irradiate the effusions of his riper genius? In what magic creation was the spirit of Shakespeare so naturalised that he culled at will the choicest flowers of fancy, and breathed, as his proper element, the atmosphere of inspiration? How and where reposed the eloquence of Cicero or Burke, till the necessities of the state, or the hardihood of villainy, bade their thunder roar, and shake the strongest battlements of corruption? What supported the magnanimity of a Chatham against royal prejudices, and the clamours of popular enthusiasm? Were there any peculiarities in the modesty of his temper, or the occupations of his retirement, which carried Newton above the philosophy of his cotemporaries, and brought him into acquaintce with the presiding powers of the universe? These are some of the many questions which every intelligent mind naturally demands in the view of whatever is excellent or praise-worthy of its kind, and to which it is the duty of the biographer to afford suitable replies. He professes to connect together the insulated events and works which have obtained publicity and fame,—to assign the real internal causes of their celebrity—to fill up the chasm between non-entity and the productions or qualities which have sanctioned admiration or drawn forth gratitude,—in a word, to renovate and render permanently accessible a worthiness which has ceased to exist. This task is evidently a trying one, and requires for its accomplishment a peculiar assemblage of properties and materials, which comparatively few who have undertaken it appear to have enjoyed.

The causes of the deficiency, generally speaking, are more to be deplored than condemned, and may therefore be glanced at without invidious disparagement. They may be arranged under three heads:—1. Imperfection or inadequacy of information;—2.

Biography

Unsuitableness, or want of talent;—3. Disqualifying temper of mind, or personal bias.

The first of these causes is perhaps the most prolific of failure. This is easily explained. The biographer cannot be expected to have more copious materials than the individual whom he means to pourtray. But how few persons are there who have had that amount, and kind of foresight, to say nothing of the industry and intelligence requisite to give it efficiency, which could prompt to the preservation of adequate memorials of their studies, their experiences, and projects? What memory can retrace the first suggestions of genius, which, animating and buoyant, and productive as they might be, were speedily dissipated in the engagements of life, or indistinguishably incorporated with their own successive offspring? What space could be reasonably spared, or at least is ordinarily given to reflection, from the aspiring capabilities of youth, its devotion to novelty, its splendid purposes, and exorbitant anticipations? It is even questionable if the every-day-memorandum disposition, were it a practicable endowment, be consistent with the luxuriance and freedom, and facility of mind, from which excellence has its impulse. Certain at least it is, that an over solicitude for punctuality and method is injurious to mental power, and betokens any thing rather than the enthusiasm of genius. Some casual recollections of his pursuits, accordingly,—a treasured feeling of affection towards a favourite author,—a conscious propensity to intermit duty and abandon interest when certain ideas shoot across his mind,—perhaps an ill-judged fondness for some relic of his youthful toil,—or the prevalence of an ungainly habit over the dictates of understanding and the claims of politeness,—are the only beacons which cast a gleam on the darkened regions of his past existence. But even these are for the most part retained in secret, as if too valuable to be exposed to the regard of mankind, and are not unusually extinguished for ever in the dissolution of the individual possessor. What hope that the sagacity of any other person shall penetrate the obscure, or collect the scanty embers by which alone it can be explored! Even the most intimate relatives are often miserably ill-informed as to the interesting and really important features and transactions of their eminent associate. They are satisfied with his present fame, and delight in the kindness and complacency, and familiarity and ease, with which he shares his advantages and success among them, and feel no solicitude about the means by which the one was realised, or practically entertain any apprehension, till it be too late, of the period when the other shall be for ever withdrawn from them. Distance of time, and remoteness of situation, are other difficulties, under this head, which impede the performance of biography. How little is now known of the private manners, and even the public transactions of the ancient world? It is a chaos, amid the disorder and darkness of whose immensity, it is scarcely possible to obtain satisfactory information of any one character by which it had been either benefited or abused.

When unsuitableness, or want of talent, is mentioned as a source of imperfection, it is not meant to be implied that any peculiarity of faculty is requisite for the office of biographer. The allusion is made to unfavourable habits, to natural debility, or positive want of the common intellectual powers and moral sentiments. It is undeniable that scarcely any man, however great his intelligence, or vigorous his industry, is equally fit for every undertaking. The very peculiarities of his constitution and temperament by which he is discriminated from the rest of his species, lead him with greater facility and hope of excellence to one pursuit rather than to another; and it is equally certain, that the habits which his propensities may have occasioned, operate as a kind of restriction on his mental powers. There are numerous examples to illustrate this position, to which it is perfectly sufficient barely to advert, without entering on general reasoning, or the discussion of metaphysical principles. The mere mathematician would engage with little chance of success in the life of Otway, or Cowper, or Burns. He who had spent the bulk of his time in conning over lexicons, and scanning the measures of the ancient tragedians, would make but a sorry figure as the delineator of Raphael, of Reynolds, or of Barry. The character of Galileo, or Newton, or D'Alembert, would receive but little elucidation at the hands of a humourist like Foote, or even from the erudition and critical sagacity of a Toup or a Porson. It is needless to enumerate instances,—every one must perceive that the biographer ought to possess something in common with his subject; to have some resemblance in taste, and habitudes, and understanding, to be familiar with the studies in which his original was occupied, and to have trodden with some celerity, and for some time, the path which conducted him to reputation. The seeming exception to this law, in the case where merely moral character is to be displayed, requires but a moment's consideration to be disposed of. A corresponding equivalent is demanded on such an occasion, which perhaps is of still less frequent occurrence than due acquaintance with any one art or science,—a knowledge of human nature, and quick discernment of the invisible motives, and apparently inert objects by which it is actuated. Scantiness of this knowledge, or, which comes to the same thing, the substitution of hypothesis and system in its place, accounts for the worse vice than inutility of many compositions in this department of literature.

To the third head may be referred the whole host of attachments, prejudices, antipathies, and delusions, whether political, religious, literary, or personal. To any one of these idols strongly inherent in the mind, it is a thousand chances to one that truth will be sacrificed, and that too, perhaps, without the slightest consciousness on the part of the worshipper. A writer, under such possession, may furnish facts, it is allowed, though these will probably be garbled, partial, and incomplete, but is as utterly incapacitated for furnishing a *life*, as the mould which is constructed for an Apollo, a Trajan, or an Antonine, to yield the bust of Vulcan, Caligula, or Domitian. Even the sturdy morality of a Johnson contends unhappily at times with his prepossessions, and in one instance at least, proved insufficient to guard his reputation for honesty against a very painful and humiliating aspersion.

Various methods have been adopted in the execution of biography, each of which has its advantages and inconveniencies. The simple narrative style, proceeding in chronological order, has been preferred by many writers for the sake of its correspondence with the continuous course of real life. It is entitled to the commendation of apparent exactness, but is apt to be defective in proper *keeping*, to use the language of painters, by giving disproportioned space and colouring to events, from the circumstance of the length of time which they occupied, and allows comparatively little importance to those momentary glances of intellect, and sudden transitions of sentiment, by which, however, though without being immediately productive of external indications, the whole character is remodelled. This plan, moreover, seems to imply the absence of design and appropriate discrimination, and is in consequence rather discreditable to the author, even admitting his success as to the main object he has in view. A modification of this method separates the life into various portions designated by some striking event, and treats of each in natural succession from the birth to the decease of the individual.

Other biographers have seized on some of the prominent features, or what may be denominated the exterior parts of their constituents, on which they bestow the chief labour of their composition, leaving the subsidiary and merely personal circumstances to serve as a sort of appendix to the performance. There are not wanting examples, even of an exclusively technical biography, if the phrase be allowable, which direct the attention altogether to the public relations and bearings of the character. This seems proper enough as an auxiliary to history, but is necessarily confined to the few personages whose lives have borne decisive influence on their age and country. The chief objection to this plan is its tendency to disjoin the individual from his actions and productions, or to create a sort of intermediate being, in whose anomalous existence, as it is almost impossible to believe, it is equally so to be interested. It would be utterly intolerable if correctly adhered to; but the absurdity of writing merely the medical history of a physician, the political life of a statesman, or the literary memoirs of a scholar, is too glaring a violation of common sense to be frequently committed by any who are at all competent to the demands of biography.

The superior chance of verisimilitude and authenticity which a man's writing his own life appears to possess over the reports and conjectures of any other person, has suggested the idea of occasionally introducing him as a narrator, by publishing his letters, or extracts from them, as obtained from his correspondents. Of the value of this substitute it is impossible to doubt. Yet there adheres to the practice, unless very guardedly and tenderly displayed, an appearance of unfairness and irreverent exposure towards the departed individual, which cannot fail to excite painful emotions in the delicate or susceptible reader. A presumption, besides, is very apt to arise in his mind, not to the advantage of the biographer's industry and skill. It would be better in general, it is apprehended, to insert the letters in the appendix as an authority, on the supposition that it is *just* and expedient to publish them at all, and to employ their contents, like any other materials, in the construction of the memoir.

The mode, it is reasonable to imagine, ought to be varied according to the nature of the case and the object intended. Perhaps the philosophical idea of the purpose of biography will generally lead to the precise means of accomplishing it. It is the representation of an individual, in the totality of his character, as contemplated in the gradations, incidents, and operations of his being, in conjunction with the physical and moral peculiarities of his constitution, and as arrayed in the natural or superinduced garb, manner, and behaviour which discriminated him from the rest of mankind while living.

A late publication by Mr Stanfield, on the subject of biography considered as a literary art, professes to specify its numerous difficulties and the means by which they are to be encountered and overcome.

BIRCH, Thomas, a voluminous English writer, descended from a family of quakers, was born in London in 1705, and, more inclined to literary pursuits than the mechanical employment in which his father was engaged, and to which he was destined, he devoted his labours to study and the acquisition of knowledge; officiated as usher in several public seminaries; and, without the advantage of a university education, was admitted to orders in the church of England. He obtained various preferments, and was elected one of the secretaries of the Royal Society, of the origin and progress of which he published a history, in four volumes 4to. Dr Birch was unfortunately killed by a fall from his horse in 1766, and in the 61st year of his age. With the assistance of several associates, he completed the elaborate undertaking of *The General Dictionary, Historical and Critical*, in 10 volumes, folio; and he published editions of various works of some of the older English writers, with biographical sketches, and different memoirs and historical tracts.

BIRD, for an account of the structure, see Anatomy; and for the classification and natural history, see Ornithology.

BIRD ISLAND, a huge rock in the southern Pacific ocean, three miles in circuit, and rising to a great height; precipitous on all sides, excepting to the westward, where it declines into a sandy beach, and exhibiting some marks of vegetation. As the name indicates, it is the abode of immense flocks of birds, and is more than 100 miles distant from the Sandwich islands.

BIRMAH, or BIRMAN EMPIRE. The countries of Ava, Arracan, and Pegu, recently independent kingdoms in the eastern peninsula of India, are now united under the sway of one sovereign, and distinguished by the name of the Birman Empire. The territories of this formidable power are situated between the 9° and the 26° of north latitude, and the 92° and 107° of longitude east from Greenwich, spreading over a surface of 200,000 square miles.

Birmah.

The western boundary of this empire is washed to a great extent by the bay of Bengal; towards the north the river Nauf, and a range of mountains, separate it on the same side from the possessions of the British East India Company. In no other direction have its limits been hitherto accurately ascertained; it is only known generally to reach to Assam and Tibet on the north, to China and Laos on the east, and to Siam and Malacca on the south. But the frontiers of a country, inhabited by people of a warlike disposition, encircled by neighbours equally prone to hostilities, must of course accompany the progress of conquest, whether it advances or recedes.

General aspect.—The external character of this extensive country, is, as we have reason to expect, greatly diversified, both in point of soil and surface. Its sea coast, which stretches upwards of fifteen geographical degrees in length, is fringed throughout by numerous islands, is indented at frequent intervals by jutting capes and retiring creeks, and is broken at various places by the mouths of many a stream; here it spreads out into a flat and sandy beach, exposed to the alternate influence of the flowing tide and the scorching sun; there it rises, with a precipitous abruptness, into proud and craggy cliffs, which sullenly repel the rage of the boisterous billows. Independent chains of lofty mountains, and branches of the stupendous ranges of Tibet, clothed with forests, or green with pastures, traverse the country. From these mountains innumerable torrents roll their streams, mingle together in the vallies, and having swollen into magnificent rivers, wind their way to the ocean through boundless plains, teeming with the richest variety of tropical vegetation. "From a temple, (says Captain Symes,) that stands on a commanding cliff close to the river Irrawaddy, the eye is gratified by a delightful combination of natural beauties: a fine sheet of water three miles in breadth, broken by an island about a mile long and half a mile wide, covered with trees of luxuriant foliage; eminences from the opposite shore, that rise from gently swelling grounds, clothed with wood, to brown and rugged mountains, which, receding in an oblique direction, leave to the view a level plain." And this, though the description of a particular landscape, is characteristic of many others equally beautiful and picturesque.

Mountains and rivers.—Many mountainous ridges from the towering heights of Tibet extend across the northern provinces of the Birman empire, and give it on that side the character of a hilly country. An extensive independent chain, called the great western mountains, runs along the coast, penetrates in a direction bending toward Bengal, far into the interior, and forms the boundary between the countries of Arracan and Ava. Another independent chain, denominated the Galladzet hills, traverses the territory of the ancient kingdom of Pegu, about one hundred miles above the city of that name. The principal rivers of this region are the Irrawaddy, the Setang, the Thalanyn, the Maygue, and the Maykaung, concerning which, and some of the less considerable streams, Dr Buchanan, who accompanied the embassy to the court of Ava in 1795, has communicated the following important information: It appears, (he observes as the result of his inquiries,) that the Arracan river is not so considerable as what has been supposed, but takes its rise in hills at no great distance to the north: That the river coming from Tibet, which is supposed to be that of Arracan, is, in fact, the Keenduem, the great western branch of the Ava river: That what is supposed to be the western branch of the Irrawaddy, is, in fact, the eastern one which passes by Ava, and runs to the north, keeping west from the province of Yunan, and leaving between it and that part of China a country subject to the Birmans: That the Lokiang, which is supposed to be the great branch of the Irrawaddy, has no communication with that river; but on entering the Birman dominions assumes the name of the Thuluang, and falls into the sea at Martaban: That the river Pegu, which is supposed to come from China, rises among the hills about a hundred miles from the sea, and which forms the boundary between the Birman and the Pegu kingdoms: That between the Pegu and Martaban rivers there is a lake from which two rivers proceed, the one runs north to Old Ava, where it joins Myoungnya, or Little River of Ava, which comes from mountains on the frontiers of China; the other river runs south from the lake to the sea, and is the Setang river in the map: That the rivers of China, which are supposed to be the heads of the Pegu river, are those of the Siam: That the rivers of Siam and Cambodia communicate by a very considerable branch called the Annan. These rivers, on entering the level land, formed chiefly by their depositions, cross and divide it in every direction by the branches into which they are separated, and fall at last by many mouths into the waters of the ocean.

Climate.—A country situated chiefly between the tropics must necessarily experience a high degree of temperature; but the health and vigour and longevity of the inhabitants afford an incontestible proof of its salubrity. The seasons are regular, and it is not subject to the extremes of heat and cold; for the intense heat which precedes the rainy season is of too short continuance to cause much inconvenience. Here, as in other tropical countries, the year is divided into the dry and rainy monsoons.

Productions.—In the richness and variety of its mineral productions the Birman empire is unrivalled. Mines of gold and silver are open in several places, and ores of iron, tin, lead, and arsenic are found in great abundance; rubies, sapphires, amethysts, garnets, chrysolites, jaspers, and other precious stones, all of the finest water, also abound in it; there are quarries of excellent marble in many of its mountains, and no other country yields amber, antimony, sulphur, or petroleum in larger quantity, or of finer quality. The soil of the southern provinces of this region is remarkably fertile, and yields as luxuriant crops of rice as are produced in the finest parts of Bengal; wheat and other grain, with a great variety of esculent herbs, grow to perfection, and in great profusion, in the vallies of its more northern and higher districts; sugar-canes, tobacco, indigo, brown and white cotton, and all the variety of tropical fruits, are among the indigenous productions of this highly favoured land; its mountain declivities also are clothed with immense forests, in which the teak abounds, a tree almost peculiar to this country, possessing qua-

Birmah.

lities suited for ship-building superior even to the oak, and therefore, in relation to her East India possessions, of incalculable importance to Great Britain.

The same animals prevail here as in hither India, such as the elephant, the horse, the antelope, the deer, the bull, the buffaloe, the tyger, &c. ducks in great variety, jungle-fowl, peacocks, storks, &c. also serpents and lizards, with other reptiles, in greater abundance than is always pleasant or safe.

Inhabitants.—Dr Buchanan is of opinion that the Birmans are a Tartar tribe. He tells us, that, like those of this race, they are distinguished by a short, squat, robust, fleshy stature; that their face assumes the shape of a lozenge, being broad at the cheekbones, and narrow at the forehead and chin; that their hair is harsh, lank, and black; and that their complexion neither darkens into the deep black of the Hindoo, nor beams out in the clear bloom of the European. The lower orders observe the savage custom of tattooing their arms and thighs, with the view of charming off the weapons of their enemies. A more peculiar custom is practised by their women: Girls at an early age are taught to turn the joint of the elbow round to the side, a circumstance which gives to their arms a distorted appearance. Their articulation seems to a stranger extremely indistinct, which may be occasioned by their excessive use of betel, &c. No man of rank speaks without his mouth being full of betel, tobacco, quicklime, and spices; hence indistinct articulation has become fashionable. With the variety of dialect, the same language is spoken throughout the empire, and also in some of the neighbouring states.

Population.—Few of the Birmans live in solitary habitations, but in cities, towns, and villages, of which the kingdoms of Ava and Pegu are said to contain 8000; and allowing to each of these, on an average, 300 houses, and to every house six inhabitants, the aggregate of the whole will be 14,400,000; and estimating the kingdom of Arracan in a similar manner, the number will increase to between seventeen and 20,000,000. This, indeed, is an uncertain method of calculation; it is, however, the only attempt that has hitherto been made to ascertain the population of this interesting part of the world.

Cities.—The habitations of this people are universally raised from the ground on posts of bamboo, or pillars of strong timber, in proportion to their weight and size. The areas of their cities are of a quadrangular form, fortified by a wall and a ditch; the streets are straight and spacious; they frequently intersect at right angles, and many of them are paved with brick. They are adorned with magnificent temples, profusely gilt; and even the private houses, though constructed chiefly of wood, have a splendid appearance. Ummerapoora, the capital of the empire, though founded so late as the year 1785, has already become one of the most flourishing cities of Asia. It stands more than 400 miles up the Irrawaddy, washed on the west by that river, and on the east by the waters of a lake. The fort is an exact square, within which are magazines of grain, military stores, &c. The royal palace occupies the centre, adjacent to which is the hall of council, supported on eleven rows of pillars. At each corner stands a temple, richly gilded, and a hundred feet in height; and many others far more magnificent are dispersed through the city. Four miles down the river are the ruins of Ava, the former metropolis. Its walls, once deemed invulnerable, now mantled with ivy, and mouldering into heaps; its temples, recently so splendid and so perfect, now the dwelling-place of noisome bats, and swiftly dilapidating under the impressions of the hand of time; and its streets, lately so crowded with busy multitudes, now covered with rank jungle grass and the fast growing bamboo, are fitted to inspire a melancholy sentiment, and to suggest the transient nature of all human grandeur. Chagaing, fronting the capital on the opposite bank of the river, was once the royal residence, and is still a populous and a mercantile city. Pegu also, once the metropolis of the kingdom of that name, was taken and sacked in 1757, and left in ruins. A new town, however, has been built within the area of the old, and it may soon regain its former magnificence. Arracan is the capital of the country which bears that name. Rangoon, situated on the eastmost branch of the river Irrawaddy, is a great sea-port, with an excellent harbour. It has long been an asylum for insolvent debtors. Prome is renowned in Birman history for having been the scene of many long sieges. Martaban and Mergni stand on the bay of Bengal, and possess excellent harbours. Besides these, there are many other cities, towns, and villages, built chiefly on the banks of the rivers. The wooden fabrics of which these cities, &c. are composed, make them extremely obnoxious to fire; and several precautions are taken against its effects by the inhabitants. Pots filled with water are ranged along the roofs; each house is provided with two bamboo poles, one with a hook attached to it to pull down the thatch, another furnished with an iron grating to suppress the flames by pressure.

Agriculture.—This country is too highly favoured by nature, and the wants of the people are too easily satisfied, for the art of agriculture to be skilfully practised; and till it was united under the auspices of one sovereign, it was too frequently exposed to the ravages of internal war to afford encouragement to the labours of the husbandman. The capacity of the soil, however, is extremely great, and might easily be made to yield more than a hundred fold. The plough here is a very rude and imperfect implement, and is drawn by oxen, as are also their carts. The fields in some places are inclosed with hedges, and the rice plantations are surrounded with embankments.

Manufactures.—The Birmans do not yet manufacture for a foreign market, but they work up a great many articles for their own use. The architecture and gilding of their temples imply skilful and dexterous artificers. They also excel in ship-building. Of their fine marble they form innumerable statues of their god Gaudma. They manufacture fabrics of silk and cotton not inferior to those of Bengal. Common salt, saltpetre, and gunpowder, are made by them in great quantities. They make great variety of lackered and earthen ware. In 1795, the monarch was anxious to avail himself of the presence of the gentlemen of the English deputation to improve his people in glass-making; but none of themselves having ever been initiated, they were unable to reveal the mysteries of the glass-house; they, however, furnished his majesty's subjects with all the information the Encyclopædia Britannica contained on the subject. This anecdote shews that this people are not above instruction, and therefore open to improvement.

Ranks.—The odious and degrading distinction of cast is entirely unknown in this country; nor are the women immured within the walls of a haram, or guarded by eunuchs, as in most other eastern nations; they have here, indeed, as much liberty as in Europe. The privileges of the nobility, however, are very scrupulously protected. The badge of the order is a chain composed of several strings, from two to twelve, according to the rank of the wearer. The king alone is decorated with a chain of twenty-four strings. But the order of nobility is distinguished by every thing belonging to them. From the houses in which they dwell, to the box which holds their betel, marks of their rank, which it is felony for a plebeian to assume, are conspicuously displayed.

Government.—Elevation of rank, however, affords to the possessor no title to engross, or even to share the offices of the state. The government of this empire recognises no hereditary dignities or employments. They all proceed from, and revert to the sovereign, who, though he administers the affairs of the empire through the medium of a numerous council, may be regarded as in full possession of absolute power. The court is splendid and ceremonious. The king is invisible, except on great occasions of state. The provinces are governed by a deputy, called Maywoon, an office which is sometimes held by the princes of the blood.

Revenue.—The sacred law allows the tenth part of the produce for the use of the state. A tenth on most imported goods is taken in kind, and distributed to the dependants of the court in place of salaries. The princes of the blood receive grants of provinces, cities, &c. to support their dignity. The Birman government exhibits almost a faithful picture of Europe during the dark ages, when the principles of feudal dependence were established by the barbarians of the north.

Army.—The regular army of this power is not large, but every man in the empire is liable to be called upon for his military service; and war is deemed an honourable occupation. When an army is to be raised, a mandate is issued from the golden palace to all the viceroys of provinces, requiring a certain number of men to assemble at a general rendezvous on an appointed day. The levy is supplied with arms, ammunition, and a certain daily allowance of grain, but is entitled to no pay. The friends at home are accountable for the good behaviour and fidelity of their relatives in arms,—a barbarous custom, sometimes productive of the greatest cruelty. The infantry wear no uniform, which gives them a grotesque and mobbish appearance. The cavalry are all natives of Cassay, and are accounted excellent horsemen. But war-boats constitute the most formidable part of the Birman military force. Every town of any magnitude is obliged to furnish these, with their entire equipment, in proportion to its size and resources. At a very short notice, the king can command more than five hundred of these vessels.

Religion.—The Birmans are votaries of Buddha, or, according to the more common appellation, of Gaudma, who is allowed by the Hindoos to be the ninth Avatar, or incarnation of the Deity in the capacity of preserver. Sublime and holy attributes are thought to characterise this personage, which, however, comport extremely ill with his representations, which are rude statues of the human form, larger than the life, generally of marble, placed cross-legged upon a pedestal, with one arm pendant, and the other brought across the body. These images are very common throughout the country, and are objects of the most profound veneration. Numerous and magnificent temples are reared at a vast expence in all the cities, and in many other places, for the worship of their divinity. They are commonly built in a pyramidical form; and many of them rise to the height of five hundred feet. The most stupendous of these piles is the temple at Pegu, denominated *Shoemadoo*, or *Golden Supreme*. This extraordinary structure is erected on a double terrace, one raised above another, ascended by flights of stone steps; on every side are the dwellings of the priests, raised on timbers five or six feet from the ground. The temple is built solid of brick, without any aperture; it is octagonal at the base, and spiral at the top; each side of the base measures a hundred and sixty-two feet; a breadth which quickly diminishes as it ascends. The spire is surmounted by the *tee*, or umbrella of open iron work; from which rises a rod, with a gilded pennon. The priests of Gaudma are called Rahaans, and resemble monks in their mode of life. Celibacy is strictly enjoined; they live in convents, wear a yellow garment, and go barefooted; their manners are simple, and their lives decent; they receive contributions of food from the laity. For this purpose they perambulate the streets with a quick pace, carrying a basket, and take what is voluntarily offered to them. They profess to spend the chief part of their time in the contemplation of the divine essence. There were once many nunneries in the country, but they have been suppressed as unfriendly to population. A most favourable feature of the Birman religion is the universal toleration which it allows. This people never trouble themselves with the religious opinions of those who visit or who dwell among them, provided they disturb not them in the exercise of their worship. Mahometans, Jews, and Christians, are summoned to prayers, in their respective manners, often in the same street. Processions meet and pass, without giving or taking the smallest offence. Persons who sustain the character of preachers of religion, no matter what be the species or the sect, enjoy greater privileges, by the order of government, than those who act in any other capacity.

Laws.—The Birman laws are closely interwoven with their religion. They are deemed of divine authority, promulgated by *Menu* from inspiration. And it must be confessed that the code is replete with good sense and sound morality. It provides specifically for almost every species of crime that can be committed; and adds a copious chapter of precedents and decisions to guide the inexperienced in cases of doubt and difficulty. It tells the prince and the magistrate their duty in language, austere, manly, and energetic. But the chapter on women is offensively indecent, and it sanctions the absurdity of trial by ordeal.

Literature.—The accomplishments of reading and writing are very generally diffused among this people. They are common even among the peasantry. They write from left to right, like Europeans, and their character is very elegant. In the king's library are books in history, medicine, law, and poetry. These books are kept in chests, curiously ornamented with gilding and japan, in which the volumes are arranged under distinct heads.

Customs and character.—With regard to their food, though their religion forbids the taking away of animal life, it does not prohibit the eating of flesh; and therefore game of all kinds is regularly sought and sold in the markets: For they interpret the prohibition of religion to apply merely to domesticated animals. Rice, fruit, and vegetables, constitute their principal aliment; though even serpents and lizards are not rejected by the lower orders. Their dress varies according to their rank. The lowest class of females wear sometimes only a single garment, in the form of a sheet, which, wrapped round the body, and tucked in under the arm, crosses their breasts, which it scarcely conceals, and descends to their ancles; thus, when they walk, the bottom of the cloth, where it overlaps, is necessarily opened by the protrusion of the leg, and displays a side view as high as the middle of the thigh. But a more decent dress is in general use. A short shift, drawn tight by strings, supports the breasts, over which is worn a loose jacket, with long sleeves. Round their waist they roll a long piece of silk or cloth, which reaching to their feet, and sometimes trailing on the ground, encircles them twice, and is then tucked in. The men wear large ear-rings of various forms; frequently they are tubes of gold, about the thickness of a quill at the one end, and expanded at the other like the mouth of a speaking trumpet. The court dress is very becoming; it consists of a long robe, either of satin or velvet, reaching to the ancles, with an open collar and loose sleeves; over this there is a scarf or flowing mantle. On their heads they wear embroidered caps, ornamented according to the rank of the wearers. The law prohibits polygamy; but a man may keep as many concubines as he pleases or can maintain. They burn or embalm their dead, which is always a religious service. Begging is unknown in this country. Their mode of welcoming in the year is singular: In order to wash away all past impurities, women have the privilege of throwing water on every man they meet; and receive a wetting in their turn with perfect good humour. On the last day of the year the young women arm themselves with flaggons and long syringes, and prepare to give the men a wet reception; yet notwithstanding this licence, no indecency is committed, nor do evil consequences ensue. In this singular amusement the men are never the aggressors. Chess is a favourite game among the Birmans, and many of them are skilful players. They are fond of fire-works, boxing matches, puppet shews, theatrical entertainments, singing and dancing.

It is obvious from the whole of these details, that this nation has made considerable advances in civilization, perhaps as great as our own ancestors a very few centuries ago. As may be expected in such a state, the character which these people display is of a mixed and even a seemingly inconsistent kind. They are humane or cruel, indolent or active, refined or gross, faithful, treacherous, sullen or cheerful, according as their unformed manners, and ill regulated minds happen to be under the influence of the spirit of the civilized or the savage state. There seems however to exist no insurmountable barrier in the way of their improvement, like that which opposes the progress of their Hindoo neighbours; and we are thereby led to believe with Captain Symes, that they are destined to rise rapidly in the scale of civilization. With respect to the importance of the Birman empire, in a commercial point of view, there can be no dispute. It possesses the advantage of water-carriage, not only from the great extent of coast, but by means of its navigable rivers opening communications with the principal parts of the country. Its climate is most salubrious; its productions are various, as they are valuable; its situation is commodious for intercourse with India, with China, with the South-sea islands, and even with Europe. Its people are fond of our manufactured commodities, and the recent abridgement of monopoly encourages a free trade with all the rich regions of the east.

History.—In the time of the earliest of our European concerns with this part of India, the Birman sovereign held the kingdom of Pegu in a kind of subjection, and exacted a tribute from its prince. In 1744, the Peguvians, imagining that they had power to throw off the yoke of the Birmans, not only renounced their obedience, but having tried their strength they pushed their enterprize still farther. They entered the Birman territory, and in 1752 took possession of Ava its capital, made its monarch a captive, and totally reduced the kingdom. An instrument, apparently feeble, was the author of the next revolution, the period of which was not long delayed. Alompra, a Birman of low extraction, the head of a petty village, was provoked to oppose the insolence of his Peguvian masters, and to drive them from his village. He was quickly joined by a band of supporters; they enabled him to defeat a small body of the enemy sent to chastise him. The ardour of the Birman was roused, and the man, notwithstanding the meanness of his birth and education, had talents to improve his advantages. He became the leader of his countrymen against their invaders. Towards the conclusion of the year 1753 he obtained possession of Ava the capital, and gained a victory over the king of Pegu, who marched in person to oppose him. Having now cleared of its enemies the greater part of his native country, he was recognized as the founder of a new dynasty, and had no inclination to stop in his victorious career. He not only recovered from the Peguvians whatever part of the Birman dominions they had usurped, but proceeded to attack them in their own territories. They were by no means able to withstand his arms; and, in 1757, Birmingham

he had so far pushed his conquests as to be able to invest their capital, which, after a short resistance, submitted, and the kingdom was delivered into his hands. He was now one of the most powerful sovereigns of the east. While he led his army against the Siamese he was seized with a distemper which quickly put a period to his life and the war in which he was engaged, in the year 1760. His son reigned in his stead; and on his demise, in 1764, his brother Shemuan, to the prejudice of his infant nephew, succeeded to the throne. He repelled a Chinese invasion, the government of which had become jealous of the Birman power. In 1783, he conquered the kingdom of Arracan, and united it to the empire. About the year 1793, some of the Birman troops made an incursion into the British possessions, in search of some robbers who had taken refuge there. A negotiation took place; the robbers were found guilty, and delivered up to their countrymen. This accidental event led to the embassy which has brought us acquainted with this interesting country. See Symes's *Account of the Embassy to Ava*.

BIRMINGHAM, a town of Warwickshire in England, which is celebrated for its numerous and extensive manufactures of hard ware goods, is finely situated on a declivity, is about two miles long, and somewhat of a crescent form. The climate of Birmingham, although the air is continually loaded with smoke and noxious vapours, from a crowded population and so many manufactures, is remarkable for its salubrity.

The lower part of the town is chiefly inhabited by manufacturers, and is occupied with their warehouses and workshops; but in the higher part the streets are regular and spacious, with many elegant buildings. The parish church of St Martin, which dates its origin in 1300, has a lofty spire; and St Philip's, or the new church, is an elegant edifice, adorned with a square tower and cupola, which is furnished with a peal of bells and a clock with musical chimes; and, beside these churches, the chapels and meeting-houses for different sects are numerous. Birmingham has the advantage of institutions for the education of the poor, for the support of the infirm, and for the relief of the diseased; public libraries, some of which are well furnished with books; a museum, in which are exhibited various objects of natural history; hot and cold baths on a large scale; a theatre, and a Vauxhall for music and other entertainments.

Birmingham is not incorporated; the municipal officers, composed of a high and low bailiff, two constables, and a head borough, are elected annually; and a court of requests, established by act of Parliament in 1752, meets every Friday for the dispatch of legal business.

Birmingham is justly regarded as one of the first manufacturing towns in the world. The tanning of leather was the chief occupation of the inhabitants in the earlier periods of its history; but after the commencement of the nineteenth century, this branch of trade declined, and is now nearly abandoned. Coarse iron wares were the only manufactures of that description before the revolution, at which time it had been usual to be supplied with fire-arms from abroad. The member of parliament from Warwickshire undertook to obtain a sufficient supply from Birmingham; the order was punctually executed; and it has since continued to furnish the largest proportion of muskets, swords, and other small arms. Various other branches of hardware manufactures were afterwards introduced; and whether they are useful, curious, or ornamental productions, they display in a remarkable manner the enterprise and ingenuity of the proprietors and managers, and the industry and delicacy of hand of the workmen and artizans. Of the progress and extent of the manufactures of Birmingham, a singular instance is recorded of Mr Taylor, who introduced gilt buttons, japanned and gilt snuff boxes, with various articles of manufacture in enamel, and who died in 1775, at the age of 64, after amassing a fortune of L.200,000. The weekly produce of Mr Taylor's manufacture of buttons amounted to L.800; and in painting snuff boxes, at one farthing each, a man could gain L.3, 10s. per week.

The population of Birmingham has increased rapidly with its thriving manufactures, since the commencement of the eighteenth century. The number of streets which at that time was not more than 30, now exceeds 250. The inhabitants, who, in 1801, were estimated at 73,670, of which number more than 62,000 were employed in trade and manufactures, had increased, in 1811, to 80,753.

Soho.—Soho, which, from the similarity of its manufactures, may be considered as connected with Birmingham, exhibits a remarkable example of enterprise, ingenuity, and industry. This remarkable spot, which is about two miles distant from Birmingham, and which, within the last 50 years, was a solitary waste, is now covered with plenty and population. The manufacture of metallic toys by the late Mr Boulton, in conjunction with his partner Mr Fothergill, was the commencement of these extensive works. Plated ware, or Sheffield plate, including various useful and ornamental articles, was next introduced. These were succeeded by a happy imitation of the French *or moulu* ornaments, composed of vases, tripods, and other works, and by elegant and massive services of silver plate. The establishment of a manufactory of steam engines, when Mr Watt, whose valuable improvements of that machine form a remarkable era in its history, became a partner in the concern, extended the celebrity as well as the profits of the works at Soho. In all the productions of this manufactory, whether in the form of large and powerful apparatus, or in that of trinkets and ornaments, novelty, taste, and ingenuity have been always conspicuous.

The coining apparatus, invented and constructed at Soho, is a singular example of mechanical ingenuity. The first coining mill was erected at this place in the year 1783, and after various improvements, eight machines, going at the same time, are driven by one steam engine. Each machine strikes from 70 to 80 pieces, of the size of a guinea, in a minute, so that between 30 and 40,000 coins are worked off by the whole eight machines in an hour. All the processes are conducted by machinery, as in copper coin,—rolling the masses of copper into sheets,—rolling them through cylindrical steel rollers,—clipping the pieces of copper for the dye,—shaking the coin in bags,—

striking both sides of the coin,—and then milling it. But one of the most curious contrivances of this ingenious machinery is, that a precise account of every piece coined is regularly kept, so that even the possibility of fraud is precluded.

Birmingham is 116 miles from London, and in its immediate vicinity two rich coal mines, and the extensive inland navigation by which the produce of its manufactures are conveyed to the principal towns of the interior of England, as well as to the chief sea-ports of the east and west coasts of the kingdom, for exportation, afford great facilities for enterprise and trade.

BISCAY, a province of Spain, bounded on the north by the bay of Biscay, on the east by Navarre, on the south and west by Old Castile and the Asturias. This province is about 40 miles in length, and about 24 in breadth, and is altogether a mountainous region, some parts of which rise to a considerable elevation. The valleys are devoted to agriculture; on some of the hills the hand of industry has succeeded in their cultivation to the very summit; and the higher districts afford pasture to herds of cattle. Fruits, particularly chesnuts, are abundant; the vine is extensively cultivated in some places, and the sides of the mountains are clothed with forest trees, or various shrubs of indigenous growth.

The mountains of Biscay afford abundance of excellent iron ore, and numerous works have been erected for the purpose of smelting the ore and manufacturing the iron. The rocks are limestone, sandstone, and various kinds of marble, and in some places argillaceous rocks predominate. Copper is enumerated among the minerals of Biscay; from salt springs common salt is obtained by boiling; and mineral waters, both hot and cold, are met with in several places.

The population of this province is estimated at 300,000, but it is said that it has decreased of late years. The chief towns are, Bilboa, with a population of 15,000, and some foreign trade; Vittoria, which numbers about 7000 inhabitants; and St Sebastians, a sea-port town, and strongly fortified, includes a population of 13,000. The abundance of iron affords materials for the manufacture of anchors, cannon, and other kinds of fire-arms, in different places; sheathing copper, and large boilers of the same metal, are fabricated at Toledo; and works for cordage and rigging are established in some of the other towns. It is said that the province of Biscay furnishes the best soldiers and sailors in Spain.

BISCUTELLA, Bastard Mithridate Mustard, a genus of plants belonging to the Tetradynamia class.

BISERRULA, Base Hatchet Vetch, a genus of plants belonging to the Diadelphia class.

BISERTA, a maritime town of the kingdom of Tunis in Africa, stands at the bottom of a fine gulf, and on the banks of a canal which forms a communication between the sea and a lake in the vicinity. The town is fortified, and defended by castles. The population, which was once more considerable, is estimated at 5000. The inhabitants are chiefly occupied in the fisheries on the lake, the millets of which are of a superior quality, and from their dried roes, botargo, which is exported to the Levant as a luxury, is made; and the surrounding territory produces corn, cotton, and various fruits.

BISHOP, a prelate who holds a barony of the king, and superintends the ecclesiastical government of his diocese. The word is derived from the Greek, signifying *inspector* or *overseer*. A similar denomination was given to certain officers among the Greeks and Romans. Of the origin of bishops, in the early ages of the Christian church, and of the nature of the authority with which they were invested, as the question involves the foundation of church government, no small diversity of opinion has prevailed. Those who are the advocates for the Episcopal establishment contend, that the name and authority of bishops were known in the earliest period of the church; and they consider the apostles themselves as bishops, from whom the jurisdiction of their successors is derived,—that the angels of the churches spoken of in the book of Revelation were the bishops of those churches,—and that some of the early fathers of the church actually received episcopal ordination from the apostles by imposition of hands. But, on the other hand, those who maintain the presbyterian form of church government, contend, that no superior jurisdiction was held either by the apostles or their immediate successors,—that the terms presbyter and bishop were applied to the same person,—and that the bishops or presbyters, in the time of the apostles, were the pastors of one congregation only; and indeed it is affirmed, that no examples are recorded of two or more churches being under the jurisdiction of one bishop. But, for a view of these arguments, reference may be made to Prettyman's *Elements of Christian Theology*, and Campbell's *Ecclesiastical History*.

The hierarchy of England is composed of two archbishops and twenty-four bishops, exclusive of the bishop of Sodor and Man, who has no seat in the House of Peers. The bishops of England are barons, and, as such, sit and vote in the House of Lords. A bishop has the title of *My Lord*, and is addressed *Right Reverend Father in God*. The bishops of London, Durham, and Winchester, take precedence of all the other bishops, who rank according to seniority of consecration. All bishops in the church of England are nominated by the king. When a vacancy happens, a *congé d' elire*, or permission to elect, is issued to the dean and chapter, with a recommendation of some person to the benefice, and the election must take place within twelve days. Consecration is then performed by the archbishop, or, in certain cases, by three bishops specially commissioned for that purpose.

BISHOPS AUCKLAND. See Auckland.

BISKUIT, or Biscuit, a kind of bread prepared in various ways. See Bread.

BISMILLAH, a solemn form of expression used by the Mahometans at the beginning of their writings and books, and signifying, *in the name of the most merciful God*.

BISMUTH, or tin glass, a metallic substance of a reddish or yellowish white colour. See Chemistry and Mineralogy.

BISSAGOS. See Bijuga.

BISSAO, an island on the north side of the Bijuga channel, on the west coast of Africa, about 40 miles long, and possessing a rich soil producing grain and fruits. The Portuguese had formerly a settlement on it for carrying on trade in wax, ivory, and slaves. The natives, like many of the African tribes, are greatly influenced by superstitious charms, of which some remarkable examples are recorded by Captain Beaver in his *African Memoranda.*

BISSUNPOOR, a district or zemindary in the province of Bengal, which includes about 1250 square miles, and is one of the most ancient estates in the province, for it appears that it has been in possession of the present proprietor's family for the long period of nearly 1100 years; and during this time they were almost independent, paying only a small tribute to the sovereign, until 1715, when the country was completely reduced. In this district the laws, the manners, and virtues of the Hindoos, are described as existing in the utmost purity and simplicity. But these accounts, it is probable, are not altogether divested of exaggeration.

BISSEXTILE, a term in chronology, denoting a year consisting of 366 days, and analogous to leap year.

BISTORT, the English name of the *Polygonum bistorta* of Linnæus, which at one time held a place in the list of medicines recommended by the colleges on account of its virtues as a tonic.

BITHYNIA, an ancient kingdom of Asia, having the Euxine sea on the north, and the Thracian Bosphorus on the west, was long governed by its own sovereigns, one of whom, Prusias II. gave an asylum to the celebrated Carthaginian general Hannibal, when he was driven from his own country, and at last betrayed him to the Romans; in the victorious career of that people, was subdued by their arms, and, on the decline of the eastern empire, fell under the dominion of the Turks, and still acknowledges the authority of the Ottoman Porte.

BIXA, ROUCOU, or ANOTTO TREE, a genus of plants belonging to the Polyandria class, and containing only one species, *orellana*, from the seeds of which the well-known dye-stuff is obtained. For the mode of preparation, see ANOTTO.

BLACK, DR JOSEPH, an eminent chemical philosopher, was born on the banks of the Garonne in France in the year 1728. His father, a native of Belfast in Ireland, but descended from a Scotch family, had resided long in France, and chiefly at Bourdeaux, as a merchant. The son, in his 12th year, was sent to Belfast for his education. From this place he removed to the university of Glasgow in 1746; and having directed his studies with a view to the medical profession, he was fortunate in becoming the pupil and friend of Dr Cullen, who lectured on chemistry; and with the aid of his powerful and penetrating genius, threw some rays on the feeble twilight which now preceded the bright day of the science which his young pupil was destined to illustrate and adorn. Mr Black removed to Edinburgh in 1750, where he completed his medical education. When he was admitted to the degree of doctor of medicine, he chose for the subject of his inaugural dissertation the investigation of the nature and properties of magnesia, in which he had been long engaged, and distinctly demonstrated the cause of causticity, or the difference between the earths and alkalies in their mild and caustic state.

When Dr Cullen was called to the university of Edinburgh, Dr Black was appointed professor of anatomy and lecturer on chemistry in 1756; but disliking the anatomical department of his labours he was permitted to exchange with the professor of medicine; and his lectures on the institutes of that science received a large share of his attention and study, while chemistry was only a secondary consideration. It seems indeed singular that the alluring path, which he had so successfully entered, was so soon abandoned. No record of his chemical researches, for several years after his appointment at Glasgow, is preserved; but, in 1761, he completed a series of experiments from which he deduced his doctrine of heat, which must ever be regarded as one of the most brilliant discoveries in the science, and one of the most important in its application to the arts of life. The detail of his experiments and conclusions, in which caution, simplicity, and precision are eminently conspicuous, was laid before the literary society in the university in 1762; formed a part of his annual course of lectures; but what seems altogether unaccountable, no published statement appeared from himself at any period of his life.

When the chemical chair in the university of Edinburgh became vacant in 1766, by the appointment of Dr Cullen to the professorship of medicine, Dr Black was again chosen his successor. Placed in a more conspicuous station, and attended by a greater number of pupils, which the high celebrity of the medical school of Edinburgh brought to his lectures, he was anxious to discharge the duties of a useful teacher; and his great object was to render his instructions intelligible to the least informed of his hearers. In the attainment of this object, no public teacher of any science ever succeeded better than Dr Black; his hearers were not only instructed, but delighted; and, by his agreeable manner, the study of chemistry became fashionable, and the knowledge of the science was rapidly extended. It has been remarked by his biographer, and with great truth, that in one point of view the effect of this was unfortunate for the progress of the science, the improvement of which he seems to have altogether laid aside, for what may be deemed by some the less important, but not less useful task of elucidating its elementary principles. Those who have had the good fortune to be the pupils of Dr Black, and who are able to appreciate his merits, will not hesitate in pronouncing him to have been one of the most perfect models of a public teacher. With a comely and interesting countenance, a fine and distinct voice, and a slow and graceful elocution, he exhibited in his lectures a degree of simplicity and elegance which has been seldom equalled and never surpassed; and, without any parade of apparatus, or ostentatious display of experiments, he confined himself to what was essentially useful for the illustration of the doctrines which he delivered

In the long period of 33 years, during which he held the chemical chair in the university of Edinburgh, although he scarcely added any thing by his own labours to the science, yet his reputation as a che-

Black.

mical philosopher never declined. This seeming indifference in promoting a science which he was so well qualified to cultivate and adorn, is ascribed partly to indolence, and partly to an enfeebled constitution, which precluded much exertion; but whatever were the cause, the fine specimens of philosophical investigation which he has left behind, must ever excite regret that his labours were not more varied and more extensive, in the wide field which was then occupied by a numerous band of successful inquirers, among whom it cannot be doubted that Dr Black's perseverance in his brilliant career would have still placed him in the first rank.

Dr Black's health had been in a declining state from the year 1793; a successor was appointed to assist him in his labours in 1796; in the following year he delivered only part of the course of lectures; and this was the last time that he appeared as a public teacher. On the 26th of November 1799, when he had reached the 71st year of his age, he died, without any convulsion or stupor to announce or retard the approach of death. "Being at table, with his usual fare, some bread, a few prunes, and a measured quantity of milk, diluted with water, and having the cup in his hand, when the last stroke of the pulse was to be given, he set it down on his knees, which were joined together, and kept it steady with his hand, in the manner of a person perfectly at ease, and in this attitude expired without spilling a drop, and without a writhe in his countenance, as if an experiment had been required to shew to his friends the facility with which he departed. His servant opened the door to tell him that some one had left his name; but getting no answer, stepped about half-way towards him, and seeing him sitting in that easy posture, supporting his bason of milk with one hand, he thought that he had dropped asleep, which sometimes happened after his meals. He went back and shut the door; but before he went down stairs, some anxiety, which he could not account for, made him return and look at his master. Even then he was satisfied, after coming pretty near him, and turned to go away; but returning again, and coming close up to him, he found him without life."

The only publications of Dr Black which appeared in his lifetime were, Experiments on Magnesia, Quick-lime, and Alkaline Substances; Observations on the Freezing of Water that has been boiled,—in the London Philosophical Transactions for 1774;—and the Analysis of the Waters of the Hot Springs of Iceland, in the Edinburgh Philosophical Transactions, Vol. II. Dr Black's Lectures, in two volumes quarto, a posthumous publication, for which the world is indebted to the care and diligence of his learned friend and associate, the late Dr Robison of the same university, cannot fail to be perused with pleasure and advantage by every student of chemistry who can be gratified with simplicity and elegance in the exposition of the science, and with peculiar aptitude and felicity of illustration drawn from the phenomena of nature or the processes of art.

The charge of plagiarism has been loosely and unguardedly brought by Dr Black's biographer, against several philosophers, in appropriating to themselves his beautiful discoveries concerning heat; and it is curious to observe with what earnestness this complaint has been propagated, even at the present day, especially against foreigners, among whom de Luc is accused of having arrogated to himself Dr Black's discovery of latent heat. In vindication of the character of that venerable naturalist, we were furnished with the means of stating the very reverse, and in the following extracts he expresses the most explicit acknowledgment of Dr Black's title to the original discovery: "Ne connoissant point le *feu latent*, dans la vapeur á toute temperature, *dont la premiere decouverte est due au* Dr Black." p. 102.—"Ce qui developpoit l'idée de *chaleur latente par laquelle le Dr Black avoit designé ce phenomene.*" p. 232.—"Le Dr Black ayant decouvert qu'une certaine quantité de chaleur disparoit, quand la vapeur de l'eau bouillante se forme, *nomma ce phenomene chaleur latente* dans la vapeur." p. 385.—*Introduction a la Physique Terrestre.*

Blackburne.

BLACK JACK, an ore of zinc, which is also denominated blende and false galena. See MINERALOGY.

BLACK LEAD, a mineral substance composed of carbone and iron, with a portion of earthy matter, is well known as the substance of which black-lead pencils are made, and is otherwise called plumbago and graphite. See MINERALOGY.

BLACK WAD is a term which is sometimes employed to designate black-lead or plumbago, and is sometimes applied to an ore of manganese. See MINERALOGY.

BLACK SEA, denominated also the Euxine, is an extensive inland sea which communicates with the Mediterranean by the straits of Constantinople, and is included partly within the limits of Europe and partly within the boundaries of Asia. It is conjectured by naturalists, with some degree of probability, that the Black sea formed at one time, by the accumulation of the waters of numerous rivers, an immense lake; and that the Aral and the Caspian, from the similarity of the fish which inhabit their waters, were parts of it. The only outlet which the increasing collection of this body of waters could force to itself, was the passage into the Mediterranean, by the Thracian Bosphorus. Extensive fisheries are established at the influx of the rivers into the Black sea; and a valuable trade has long existed between the mercantile adventurers of Europe and the east, in exchanging the productions and manufactures of different countries. The Black sea is often subject to tremendous storms, and in some parts of it the navigation is dangerous, from shoals and sand-banks.

BLACKBURN, a town of Lancashire in England, stands on the banks of the river Derwent, in a valley encompassed with hills, and, it is said, derives its name from the blackness of the water of the river. The population exceeds 15,000, and thriving manufactures of cotton, calicoes, and muslins have been established. The coal in the vicinity, and the advantage of extensive inland navigation, afford great facilities to the manufactures and trade of this place.

BLACKBURNE, FRANCIS, a learned English clergyman and theological writer, was born at Richmond in Yorkshire in 1705, and having finished his grammatical education was admitted, in 1722, a pensioner of Catharine-hall, Cambridge; and, after receiving clerical orders, was inducted to the rectory of his native town; and at a later period, 1750, was preferred to the archdeaconry of Cleveland, and to the prebend of Bilton. In the course of a long life, archdeacon Blackburne was not only assiduous in the discharge of his pastoral duties, but was the author of numerous works either with regard to the doctrines or forms of Christianity; and all his writings discover the marks of an intelligent mind, strongly attached to civil and religious freedom. Even his controversial treatises, divested of the asperity which often accompanies such productions, are distinguished by their decency and moderation, and afford both entertainment and instruction to the general reader. *General Biography.*

BLACKLOCK, Dr Thomas, a poet and clergyman of the church of Scotland, was born at Annan in Dumfries-shire in the year 1721, and was scarcely six months old when he was deprived of his eye-sight by small-pox. His love of literature appeared early; and his father, an intelligent mechanic, and other friends who were most frequently near him, fostered the inclination, by reading to him such books as were suitable to his age. The gentleness of his disposition, not less than compassion for his misfortune, encouraged them in these kind offices, and made them assiduous in their endeavours to promote his instruction and amusement. With their assistance he acquired some knowledge of the Latin language. He was delighted with poetry; and at the age of twelve composed a poem which appeared in the collection published after his death.

The marriage of young Blacklock's sister with Mr M'Murdo, an eminent brewer in Dumfries, and an accomplished man, was a fortunate connection for the young poet; it introduced him into better society,—afforded him at last the advantages of a liberal education,—and was some alleviation for the loss which he sustained by the sudden death of his father, who, in attempting to extinguish a fire which had broken out in his son-in-law's brewery, perished in the flames. This afflicting incident is pathetically lamented in the soliloquy which was composed soon after. The fame of Blacklock's genius and attainments had now spread beyond the narrow circle of his own friends and acquaintances; and the accidental visit of Dr Stevenson, an eminent physician in Edinburgh, at Dumfries, afforded that gentleman an opportunity of becoming acquainted with his talents, and of exciting an interest in his future destination. Under his patronage, Blacklock, then in his twentieth year, commenced his studies at the grammar school of Edinburgh; and continued to prosecute them, with his usual diligence and assiduity, till the flames of civil war burst out in 1745. During his residence in the metropolis he added the knowledge of the French language to his literary acquirements; and at this early period of his life appeared as an author, by the publication of a small collection of poems.

While the rebellion raged in the kingdom, Mr Blacklock retired to Dumfries, where he found an hospitable asylum in the house of his brother-in-law, and enjoyed the agreeable society of several intelligent men, whose acquaintance and friendship he had obtained. The return of public tranquillity permitted him to resume his studies in Edinburgh. Having completed the usual course of academical education, and the prescribed term for the study of theology, he was licensed to preach the gospel in the year 1759; and, as a preacher, the warmth of his piety, and the elegance of his compositions, soon procured him a high degree of celebrity among the more enlightened classes of society. Previously to this time a second edition of his poems appeared in 1754; and two years afterwards a quarto edition, encouraged by subscription, in which his celebrated countryman David Hume, and Mr Spencer, professor of poetry at Oxford, who prefixed an account of Blacklock's life and writings, took a deep interest, was published in London. Of Blacklock's assiduity and activity of mind, a striking example is recorded, in the plan which he projected of preparing a course of lectures on oratory for the instruction of public speakers, and particularly for those who were destined to the bar or the pulpit. Mr Hume, with whom he had contracted a close intimacy, was consulted, and, being doubtful of success, dissuaded him from the attempt; and then it is said the resolution was formed of devoting himself to the clerical profession.

A trying period of Blacklock's life now approaches. In the year 1762, through the interest of the Earl of Selkirk, he was presented to the church of Kirkcudbright. But, either from political animosities between his noble patron and the inhabitants of the borough, or the violent prejudices which then existed against church-patronage, or from the afflicting privation under which he laboured, and which his destined parishioners might suppose disqualified him, in some degree, for the discharge of his pastoral duties, or from the polished style or elegant composition of his discourses, which were not exactly adapted to common minds, or from the combined effect of all these causes, it soon appeared that a marked opposition was to be made to his reception in the parish. On the day of his ordination, he entered the town amidst the hisses and hootings of the populace; and with some difficulty he and his friends reached the church where the ceremony was to be performed. This cruel hostility inflicted a deep wound on his delicate feelings; and threw a dark gloom on the pleasing prospect which reason and fancy had pictured to his imagination, of happiness to himself and usefulness to others in his future labours. A protracted litigation of two years terminated in a compromise, by which he resigned the living, and accepted of a moderate annuity.

A short time before he was ordained, Mr Blacklock married Miss Johnston, the daughter of an eminent surgeon in Dumfries; a connection which proved the great solace and blessing of his future life, and afforded him, with all the tenderness of a wife, all the zealous care of a guardian and friend. With the slender provision which he received from the living which he had resigned, he removed to Edinburgh in 1764; and, for the period of twenty-three years, continued to receive into his house as boarders a number of young gentlemen, whose studies he assisted by his superintendence and advice. Soon after this

Blackmore. period, the degree of doctor of divinity was conferred upon him by the university of Aberdeen, at the recommendation of Dr Beattie, then rising into poetical fame, and an admirer of his genius. Dr Blacklock's advanced years, and declining health, required him, in 1787, to relinquish his labours in superintending the tuition of young men, and to indulge in that repose which was not to be found in a crowded family. Fits of despondency, to which he had been subject even in his earlier youth, recurred more frequently; and neither the kind attention of his friends, nor the unceasing care of a most affectionate wife, was able at times to counteract their effects on his spirits. After a week's illness, death removed him from all worldly cares in 1791.

Subject to the same privation, individuals with extraordinary powers and acquirements have appeared. Among these rare occurrences in the history of mankind, Dr Blacklock's genius shines conspicuous. The accuracy and beauty of description of visible objects, which adorn his writings, are not the least remarkable features in the works of Blacklock, who, it will be recollected, was deprived of his sight in early infancy. "Blacklock, (says a learned foreign critic,) to posterity will seem a fable; as to the present age he is a prodigy. It will be thought a fiction that a man, blind from his infancy, besides having acquired a surprising knowledge of Greek, Latin, Italian, and French, should at the same time be a great poet, and without having ever seen the light should, notwithstanding, be singularly happy in his descriptions." The poetry of Dr Blacklock is justly characterised by his biographer as breathing the purest spirit of piety, virtue, and benevolence; and his prose works are distinguished by just philosophical reflections and elegant composition.

BLACKMORE, Sir Richard, an English physician and poet, was a native of Wiltshire, and was born about the year 1650. Educated for some time in a country school, he was sent to Westminster in his thirteenth year, became a student at Oxford in 1668, and, after a long residence of twelve or thirteen years, is supposed to have left it without adding much to his stock of literature, at least this is inferred from the careless or inaccurate manner in which the ancient names of places or nations are introduced in his poems. Having travelled for some time on the continent, and having been admitted to the degree of doctor of medicine at Padua, he returned to England, and obtained high eminence and extensive practice as a physician in London. His residence was in Cheapside, and his friends were chiefly in the city. In the early part of Blackmore's time, as Dr Johnson remarks, a citizen was a term of reproach, so that the place of the physician's abode was a topic to which his adversaries had recourse in the penury of scandal; nor did they forget to publish, as another ground of reproach, that he had been compelled by indigence in some part of his life to undertake the humble, but surely not dishonourable, task of teaching a school,—the only reproach, it is observed by Johnson, in his strong but peculiar manner, which all the perspicacity of malice, animated by wit, has ever fixed on his private life.

It is not a little singular that the first production of Blackmore which was presented to the world was a heroic poem, *Prince Arthur*, published in 1695, in ten books, and written, as he relates, "by such catches and starts, and in such occasional uncertain hours as his profession afforded, and for the greatest part in coffee-houses, or in passing up and down the streets." In two years more, such was the activity of his fertile muse, *King Arthur*, another heroic poem, in twelve books, appeared. About this time he was appointed one of King William's physicians, and was raised to the honour of knighthood, with the present of a gold chain and medal. The malignity of the wits, by whom he was assailed from all quarters, ascribed these marks of royal favour to his new poem; but his good fortune is more justly to be attributed to his attachment to the principles of the revolution. On the accession of Queen Anne he was also appointed one of her Majesty's physicians. Blackmore continued to write to the end of his days, but the extensive practice which he enjoyed during part of his life forsook him towards its close, when he employed his unwelcome leisure in writing books on medical subjects, and endeavoured to teach others to cure those whom he could himself cure no longer. Exhibiting in his last hours unequivocal marks of the most fervent piety, he died in 1729.

Four heroic poems were the offspring of the prolific muse of Blackmore. Beside those already mentioned, *Eliza* and *Alfred*, the first in ten, and the second in twelve books, were the titles of the other two; and of these epic poems, it is observed, the first had such reputation and popularity as enraged the critics; the second was at least known enough to be ridiculed; the two last had neither friends nor enemies. *A paraphrase on the Book of Job, a Version of the Psalms, Creation, the Redeemer, a Satire upon Wit*, are enumerated among the poetical productions of Blackmore; beside which, he wrote the *Lay Monastery*, a periodical work, in the manner of the Spectator, various tracts on medical subjects, and even ventured into the difficult path of theological controversy, by writing two books against the Arians. The name of Blackmore, by the unceasing enmity of cotemporary wits, whose judgment has been hastily confirmed by the undiscriminating censure of succeeding critics, is proverbial for dullness. But some critics, both of his own age and among posterity, have been disposed to do him justice. His poem of *Creation* was commended by Addison; and Johnson pronounces, that "it wants neither harmony of numbers, accuracy of thought, nor elegance of diction; it has either been written with great care, or, what cannot be imagined of so long a work, with such felicity as made care less necessary. Its two constituent parts are ratiocination and description. To reason in verse is allowed to be difficult; but Blackmore not only reasons in verse, but very often reasons poetically, and finds the art of uniting ornament with strength, and ease with closeness. This is a skill which Pope might have condescended to learn from him, when he needed it so much in his moral essays. In his descriptions both of life and nature, the poet and the philosopher happily co-operate; truth is recommended by elegance, and elegance sustained by truth." Johnson's *Lives of the Poets*.

BLACKNESS is that quality of a body, or peculiar texture of its surface, in which the larger proportion of the rays of light is absorbed; and in this sense it is opposed to *whiteness*, or that condition of a body which reflects the greater part of the rays of light which fall upon it.

BLACKSTONE, Sir William, a celebrated English lawyer, was born at London in 1723, was educated at the Charter-house school, and in his fifteenth year was entered at Pembroke college, Oxford. Poetry and the fine arts seem to have occupied a considerable share of attention in his early years; for, at the age of twenty, he composed a treatise on architecture; and when he commenced the study of the law, which was now his destined profession, he expressed his regrets at leaving the flowery paths of classical literature for the less inviting details of legal research, in an elegant poem, entitled, *The Lawyer's Farewell to his Muse*, which afterwards appeared in Dodsley's collection. In 1741 he was entered in the Middle Temple, was elected a fellow of All Souls college in 1743, and was called to the bar in 1746. But as he was deficient in those popular talents which more certainly insure the success of a public pleader than less splendid but more substantial acquirements, he made so little progress in procuring employment that, after seven years attendance at the courts of Westminster, he determined to abandon this part of his professional practice, and to retire to his fellowship.

To supply a striking defect in the system of education in the English universities, Mr Blackstone prepared a series of lectures on the laws of England, and delivered the first course at Oxford in 1753; and he continued it for several years with much reputation. In 1758 he was elected the first Vinerian professor at Oxford, in consequence of an institution having the same view, which was liberally endowed by Mr Viner, for promoting the study of the municipal law in that university. His lectures acquired him great reputation, and encouraged him to resume his professional practice at Westminster hall; and, in this second attempt, it appears that he was sufficiently successful. In 1761 he obtained a seat in parliament, and two years afterwards was appointed solicitor-general to the queen. His marriage in 1761 required him to vacate his fellowship, on which he was nominated principal of New-inn hall; but he resigned this office, along with the Vinerian professorship, in 1766. In 1770, declining the office of solicitor-general, he was appointed a judge of the court of common pleas, which station he held till his death in 1780.

Beside some pieces of a local and temporary nature, he was the author of *Law Tracts*, a collection of treatises, some of which had previously appeared in a separate form, which was published at Oxford in 1762, in two volumes, the first of which contains an essay on Collateral Consanguinity, Considerations on Copyholders, and a treatise on the Law of Descents; and the second includes the Great Charter, and Charter of the Forest, &c. with an introductory discourse on the history of the charters. But the great work which has given celebrity to the name of Blackstone is, his Commentaries on the Laws of England, in four volumes, the first of which was published at Oxford in 1765. This valuable work comprehends the substance of his lectures, and is justly regarded as the most popular book on the municipal laws of England which has yet appeared. The industry and research, the accuracy and judgment which it displays, and the elegance and interest with which the subjects are treated, render it not only useful as an excellent elucidation of the laws of England to the professed student, but highly instructive to the general reader.

BLAIR, Robert, a poet and clergyman of the church of Scotland, was the eldest son of the Rev. David Blair, one of the ministers of Edinburgh; was born about the beginning of the 18th century; and having completed his academical studies in the university of his native city, and spent some time on the continent, he was, after his return, admitted, in 1731, minister of Athelstaneford, a country parish in the county of Haddington. In this retired situation, which afforded few incidents for biographical notice, he passed the remainder of his life. But, to his praise, it is recorded, that he was a serious and animated preacher, an accomplished scholar, with a fine taste and polished manners, and was greatly respected by all classes in his neighbourhood. He was much devoted to the study of some departments of natural history; and it would appear from the correspondence which he held with Mr Baker, the author of several works on the microscope, that he employed some part of his leisure in microscopical researches.

As a poet, nothing is known of the progress of Mr Blair in his devotion to the muses. His first poetical effusion which was presented to the public, was a poem to the memory of Mr Law, professor of Moral Philosophy in the University of Edinburgh, who was his relation, and whose daughter he afterwards married. This poem, although it is to be regarded as a juvenile production, displays much pathos and energy, expressed in simple and beautiful language. But the *Grave* alone, which has been long one of the most popular poems in the English language, is sufficient to confer a high degree of celebrity on the author. With the exception of the poetry of Milton, it has been pronounced one of the best pieces of blank verse in the language; and if a fine glow of sympathetic feeling, animated description, and striking imagery, be essential to poetical composition, and by their combined effects produce that magic charm which touches every bosom, the Grave of Blair is entitled to this high commendation.

This excellent poem was not published till after the author's death. Through the mediation of the celebrated Dr Watts, whose approbation it obtained, it was offered, in 1741, for publication to the London booksellers; but they declined it as a hazardous speculation; thus affording at once a decided proof of want of taste and literary enterprise. But surprise may cease, when it is recollected, that the sublime effort of the epic muse, the *Paradise Lost* of Milton, brought the author only fifteen pounds, and found few readers, till the criticisms of Addison examined its merits, and displayed its beauties. It is not a little remarkable, that the Grave was read and admired for nearly half a century before any thing

Blair.

was communicated to the public of the author. This seeming neglect is more to be wondered at, when it is known, that some of his relatives rose to the highest literary eminence; and, among others, the professional labours of his cousin, Dr Hugh Blair, might have led him, with an amiable and pardonable partiality, if partiality it might be called, to commemorate his virtues and illustrate his works. The first sketch of his life was drawn up by Dr Anderson, and is inserted among his *Lives of the Poets*. Mr Blair died in 1746, and was succeeded by another poet, Mr Home, the well-known author of the tragedy of *Douglas*. Of a numerous family, one of his sons, Robert, was eminent as a profound lawyer, and rose to the high rank of Lord President of the Supreme Civil Court in Scotland. His sudden and premature death, while he held that conspicuous station, excited the deepest regret for the loss which the country sustained of an upright and accomplished judge.

BLAIR, Dr HUGH, a distinguished clergyman of the church of Scotland, and celebrated author of sermons, and writer on belles lettres, was born at Edinburgh in 1718. His great-grandfather, descended from the ancient family of the same name in Ayrshire, was minister of St Andrews, and chaplain to Charles I. and was one of the most accomplished scholars of the age in which he lived. The father and grandfather were respectable merchants in Edinburgh; but the former being concerned in some of the ruinous speculations of the times, saw himself reduced in his pecuniary affairs, and was forced to retire from mercantile business, and to accept of an office with a limited income in the excise. Deprived of all prospect of paternal inheritance, young Blair found it necessary to trust to his own personal exertions, and for this purpose very early directed his views to the church as his future profession.

Having passed through a grammatical course of education, he was admitted in his twelfth year a student in the university of Edinburgh; and at this seminary he continued for the long period of 11 years, assiduously and successfully occupied in acquiring that knowledge which the duties of his destined profession required. An essay on *the beautiful*, which he composed as an exercise while he was a student in the logic class, was highly approved by the professor, was read in public at the end of the session, and was regarded as an excellent specimen of his talents for composition, and a favourable earnest of his future fame. About this time, it is said, Dr Blair adopted a plan of study which greatly contributed to the accuracy and extent of his knowledge, and which he continued to practise occasionally through life;—in making abstracts of the most important works which he read, and in digesting and arranging them under appropriate heads according to the train of his own thoughts, the facts thus collected were retained and fixed in his mind. In this manner he studied history; and in conjunction with some youthful associates he constructed a comprehensive scheme of chronological tables. At this time the university of Edinburgh numbered among her pupils, Dr Robertson, Dr Smith, Mr Hume, and others, who became afterwards conspicuous in the civil, the ecclesiastical, and literary history of their country. With such friends and associates Dr Blair lived in habits of close intimacy; and, from their example and conversation, he could not fail to extend his knowledge and improve his taste.

Having finished his academical course, he was licensed to preach the gospel in 1741; his first appearances in the pulpit secured to him the reputation of an eloquent preacher; in the succeeding year he was presented to the parish of Colessie in Fife; and another year had not elapsed when he was appointed to the second charge of the Canongate of Edinburgh. In this situation he spent eleven years, discharging the various duties of the pastoral office, and rising in reputation by the excellent compositions which he delivered from the pulpit. In 1754 he was removed to Lady Yester's, one of the churches of the city; and four years afterwards he was appointed to the High Church of Edinburgh, which his biographer has strangely characterised as the most important ecclesiastical charge in the kingdom, —a singular assertion of any station in the church of Scotland, where no distinction of rank exists, and no difference of influence or authority is permitted, except what arises from respectability of character or superior intellectual attainments.

Dr Blair had hitherto confined his literary labours chiefly to the composition of sermons, which had acquired for him so much merited celebrity among those who heard him from the pulpit, and extended his reputation when they were afterwards presented to the world. Two sermons preached on particular occasions, some translations in verse of passages of scripture for the psalmody of the church, and a few contributions to the Edinburgh Review, a publication begun in 1755 and conducted for a short time, it is said, by some of the ablest men in the kingdom, were the only productions of Dr Blair which had yet appeared. Having now some leisure on his hands, and unwilling to permit his talents and industry to be unemployed, he projected a scheme of lectures on composition; and he delivered the first course in the college during the session of 1759. His lectures were well attended and highly approved by those who heard them; and the applause with which they were crowned, and the influence of a recommendation to government, led to the endowment of a professorship of rhetoric and belles lettres in the university of Edinburgh, and to the appointment of Dr Blair to fill that office. When declining health required him to resign the active duties of the professorship in 1783, these lectures were published; and, as they exhibit the most decided marks of acute judgment, fine taste, and critical skill, have added much to the celebrity of the author.

About this time, some fragments of ancient poetry, ascribed to Ossian, appeared among the literary circles of Edinburgh, and attracted the notice of some of the first characters of the Scottish metropolis. At the solicitation of Dr Blair and Mr Home, the celebrated author of the tragedy of Douglas, Mr Macpherson was induced to publish them; and they took a warm interest in promoting the subscription, which enabled him to make a tour through the Highlands of Scotland, for the purpose of collecting the materials of Fingal, and of other poems which bear the name of Ossian. Whatever opinion may be formed of these extraordinary poems, or of the extraordinary manner in which they were ushered into the world, the dissertation of Dr Blair, which was published in 1763, spread the author's reputation throughout Europe, and for beauty of language, delicacy of taste, and acuteness of critical investigation, stands unrivalled.

The first volume of his sermons was published in 1777; three other volumes appeared at different intervals, and all of them received the undivided approbation of the public; they circulated rapidly wherever the English tongue extends, and were soon translated into almost all the languages of Europe; and in 1780, a more substantial reward than empty fame awaited the author, by the grant of a pension from government of L.200 a-year, which was continued to his death.

Dr Blair married in 1748 his cousin Catharine Bannatyne, daughter of the Rev. James Bannatyne, one of the ministers of Edinburgh. A son, who died in infancy, and a daughter, who lived to her 21st year, the pride of her parents, and adorned with all the accomplishments that became her age and sex, were the offspring of this marriage. His wife, who had shared his fortunes and his happiness for nearly half a century, died in the year 1795. These domestic afflictions could not fail to make a deep impression on his mind; but he bore them with the fortitude of a man, and the resignation of a Christian. His increasing infirmities had, for some years before his death, rendered him unequal to the labour of the public discharge of his official duties. But his habits of industry did not permit him to waste even the close of life in idleness. His last summer was devoted to the preparation of his fifth volume of sermons; and it is not unworthy of record, that the sermon on a life of dissipation and pleasure, was the last which he composed. Towards the end of December 1800, he was seized with his last illness; and after three days suffering, and retaining to the last moment the full possession of his mental faculties, he expired on the 27th, when he had reached the 83d year of his age.

Of the private character of Dr Blair, it is scarcely necessary to say that it was highly respectable. His conduct through life was marked by prudence, purity, and dignified propriety; and of his sermons, which are so universally read and admired, it is needless to add, that they will long remain durable monuments of the piety, the genius, and sound judgment of their author.

BLAKEA, Wild-rose, a genus of plants belonging to the class Dodecandria, of which the first discovered species is a native of moist shady places in Jamaica.

BLANC, MONT, a stupendous mountain of Savoy, the highest of the whole group of the Alps, and the most elevated land in Europe, has been distinguished by the appropriate appellation of *white mountain*, from the snowy mantle which constantly veils its lofty summit, and clothes its sides for many thousand feet from the top. The mountain terminates in a ridge, in a horizontal position, stretching from east to west, and sloping on the different sides with various degrees of rapidity; and the ridge, especially towards the west end, is so narrow, that not more than two persons can walk abreast. The surface of the snow is scaly, and in many places covered with a crust of ice, under which the snow is dusty and has little coherence; and the covering of snow is so thick that no rock is seen within 150 yards of the top. The prevailing strata of Mont Blanc are composed of granite; but in some places beds or masses of steatitic and schorlaceous rocks are observed. The height has been variously estimated by different naturalists at 15,304 feet, 15,662 feet, and 15,680 feet, or nearly three miles above the surface of the sea.

Clothed in a perennial wintry robe, and elevated among the bleak regions of the unceasing storm, the summit of Mont Blanc seems to bid defiance to the approach of the adventurous traveller. To scale its stupendous height was long regarded as a hopeless and impracticable task. The first attempt to reach the top was made by M. Couteran and some attendants in 1776. On the 13th of July of that year, he departed from the priory of Chamouni at 11 o'clock at night; having ascended to the height of 13,000 feet, he was compelled to abandon the arduous enterprise; and, after a most fatiguing and dangerous journey of 22 hours, returned to Chamouni. M. Bourrit, on the 11th of September 1784, reached a very considerable elevation; but the intensity of the cold obliged him also to relinquish the undertaking. An attempt by the same traveller, accompanied by M. de Saussure, in the succeeding year, likewise failed. Dr Paccard, a physician of Chamouni, along with some of the guides of the place, was the first who surmounted the difficulties of the ascent, and, after a journey of 15 hours, reached the summit of Mont Blanc; remained half an hour on this elevated spot, and experienced great uneasiness from the intense severity of the cold. In August 1787, M. de Saussure was also successful in this daring attempt. The fatigue of the ascent, and the rarity of the air, rendered respiration extremely difficult and laborious, even with the slightest exertion. A few lichens were the only indications of vegetation observed on the higher parts of the mountain; the beautiful moss campion, *silene acaulis*, Lin. disappeared beyond the height of 12,000 feet; and no animal whatever seems to have its permanent abode in these inhospitable regions. Two butterflies on the wing were seen near the summit, but it was supposed that they had been carried up by the violence of the wind.

BLANC MONT, a department of France, including the former Savoy, lying on the west side of the Alps mountains, and having the department of Leman on the north, and the department of Upper Alps on the south. The Arc and the Isere are the principal rivers; some metallic ores, as iron, copper, and lead, are abundant; and the population exceeds 282,000. Chamberry is the chief town. The operation of smelting iron is extensively conducted.

BLAST-FURNACE. See Furnace.

BLASTING OF ROCKS is an operation which is usually performed by the explosive force of gunpowder, for the purpose of separating a mass of rock

Blasting.

from the solid strata, or of reducing a detached mass to smaller pieces, for the convenience of removal, or to be applied to certain uses. In the usual mode of conducting this process, a circular hole is made in the rock, by means of a chissel, to the depth of 12 or 14 inches. The hole is filled to the height of a few inches from the bottom with gunpowder; the upper part is closely rammed with clay or small fragments of stones; a sharp pointed iron rod is thrust down to the gunpowder; and when it is withdrawn, the vacant space is either filled with gunpowder, to act as a train to what is deposited in the bottom of the hole, or a straw filled with gunpowder is inserted. By means of this train the gunpowder is kindled; and a slow burning match is so placed, that it shall communicate to the train after the workman has sufficient time to secure himself from the projected fragments of the stone. But by driving in the rammer forcibly, premature explosions have sometimes occasioned terrible accidents. Such dangers are completely obviated by introducing the straw along with the gunpowder, and filling up the hole with dry loose sand; and by this simple management the explosion is equally efficient. Quicklime has been proposed as a kind of substitute for blasting rocks. The lime is introduced into the hole when newly calcined, and when suddenly slaked with water, it is supposed that the expansive force produced by the increase of bulk would rend the stone in pieces.

Methods of blasting rocks without gunpowder have been practised. The method adopted in Wiltshire, is to undermine the rock for a yard in length and half a yard in depth, and having introduced straw or brushwood into the cavity, to set it on fire, the heat of which expands the air within the stone, and its elastic force bursts it into pieces. A simpler method is to kindle a coal fire on the top of the stone, as in the case of large rounded stones in fields to be brought under culture, and when it has become red hot where it is in contact with the burning coals, to dash cold water upon it; and in this way, by the sudden and unequal contraction, the stone is reduced to fragments. Where coal is abundant this method may be both effectual and economical.

Mr Knight has invented an apparatus for blasting logs of wood by means of gunpowder. The instrument is a hollow screw. An auger hole is made in the log to be split; a quantity of gunpowder is put into the bottom of the hole; the screw is fixed in it nearly to the gunpowder; a match, prepared in the usual way, is passed through the hole in the screw till it touch the gunpowder; and being set on fire, its explosive force tears the log asunder.

Blatta.

BLATTA, the Cock-roach, a genus of insects belonging to the order hemiptera, of which one species, the American cock-roach, seems to be naturalised in some parts of this country, particularly in sea-port towns, to which it has been brought along with imported goods.

BLEACHING.

Introduction

THE materials of which cloth is made, whether derived from vegetables or animals, as they are produced in nature are rarely in that state of purity which answers the demands of the more improved periods of civilized society. Exclusive of those substances which adhere to them in the progressive operations of their fabrication, and which are generally removed by simple washing in water, with some slight addition, they are intimately combined with certain colouring matters, which can only be separated by chemical processes, the effects of natural agents, or applied by means of art. Hence it is obvious, that the art of bleaching, from the French word *blanchir*, "to whiten," belongs to an age of luxury and refinement, and that it is in vain to search for its origin in the remote and barbarous periods of antiquity; and accordingly the improved state of the art is of modern date, and can be traced no farther back than the close of the 18th century, when chemistry, in the progress of its brilliant discoveries and endless applications to the purposes of life, was directed to an examination of its principles, and to the improvement of its practice.

Bleaching, in its more restricted meaning, is applied to the whitening of cloth, or the materials of which it is made, which are derived from vegetable substances; but in a more enlarged sense it may include the whitening of both vegetable and animal matters, and, with no great impropriety, may be extended to every detersive or purifying operation.

History.

History.—About the middle of the 18th century, the excellent fabric, and especially the perfect mode of bleaching Dutch linens, brought them into high repute in every part of Europe, and hence the name *Holland cloth* is not forgotten in this country at the present day. The most celebrated bleaching grounds of Holland were in the vicinity of the village of Bloemendaal, about three miles from Haarlem. The remarkable whiteness of their linen was ascribed to the lye-ashes of Muscovy, and to the water of the downs, which was said to be sea-water filtrated through banks of sand; but this must be a mistake, for sea-water could not become fresh merely by passing through sand. When the successful modes of bleaching at this establishment were compared with the less perfect processes which were attempted in other places, a groundless prejudice was excited that no perfect bleaching could be effected at a distance from the sea. But the cloth bleached at this place was not merely the produce of the manufactories in the vicinity. The greater part was made in Silesia, and, after being bleached at Haarlem, was sold under the name of Dutch cloth, or Hollands. About the same time all the linen which was manufactured in Scotland was sent to the same place to be bleached, and such goods were distinguished by the name of *Scotch Hollands*.

It is probable that the Dutch mode of bleaching was first introduced into Ireland, where it was long conducted on a larger scale than in any other part of the British dominions. The first attempt in Scotland was made by a native of that kingdom; but whether he acquired his knowledge of the art from the practice in his own country, or by direct communication with Holland, is not recorded. He established a work in the north of Scotland in the year 1749; and in the hope of completing at home the preparation of their goods for the market, some of the principal manufacturers entrusted him with the bleaching of their linens; but he failed in his processes, and the disappointed manufacturers were obliged to transmit their cloth to Holland to be cleared and finished. One whole season and the half of the next were occupied in bleaching another parcel, and with no better success; but the experience and observation of a few years enabled him to improve his processes, and he became at last an excellent practical bleacher; his industry and intelligence were rewarded with affluence; and to this enterprising individual the manufacturers of Scotland were indebted for the means of preparing their linens for the market without foreign aid.

The discovery of oxymuriatic acid by Scheele, in 1774, and the application of that powerful agent, by Berthollet and other French chemists, to the processes of bleaching, constitute one of the most remarkable eras in the history of the art; and the compounds of that substance with the alkalies and earths, which rendered its use safer and more commodious, especially the combination with lime, which was first proposed and successfully tried by Mr Tennant of Glasgow, have contributed in a high degree to its improvement and perfection.

The different kinds of stuffs which are to be purified or whitened, from the diversity of elements of which they are composed, require to be subjected to different processes, and the application of very different ingredients, in the operation of bleaching, according as they are of an animal or vegetable nature. It may be, therefore, convenient to treat of them under separate heads.

Chap. I. Of Bleaching Linen.

As the object of bleaching is to separate the colouring matter from the stuffs which are to be whitened, it is undoubtedly of great importance to investigate its nature and properties, for the purpose of applying the different processes according to just chemical principles; and perhaps this subject, which shall be slightly adverted to before entering on the detail of the operations of bleaching, is worthy of a larger share of the attention of those who are engaged in this valuable department of our manufactures.

Sect. I. *Of the Colouring Matter of Linen.*

The colouring matter of linen yarn or cloth which is to be removed by bleaching, is either naturally combined with the vegetable production during its growth, or unites with it in some of the operations to which it must be subjected in the progress of manufacture. A minute examination of the changes which it undergoes, from the period of the plant ripening to its fabrication into yarn or cloth, when it is put into the hands of the bleacher, would greatly assist in deciding this point. In the mean time, a slight sketch of some of the previous processes may be useful.

Steeping flax.—The first operation to which flax or hemp is subjected, after being ripe, is steeping or watering; the object of which is to separate the fibres, which are to be formed into thread, from the other parts of the plant. This object is accomplished by a kind of fermentation or decomposition, which the sap and wood of the plant undergo, while the fibres, are little affected by proper management during the operation. This process is conducted either by steeping the plants tied up in bundles in water, which is called *water-rotting*, or by spreading them out on the grass, and thus exposing them to the moisture and dew of the atmosphere, which is called *dew-rotting.* Without considerable precaution, the fibres of the plants sometimes receive considerable injury in this process; and, with a view to obviate this effect, an improved method of watering has been proposed, by which the time necessary for the process is greatly abridged. In this method, a weak alkaline lye is employed instead of pure water. The plants are introduced into a chamber of twenty or thirty feet square, and the steam of water impregnated with caustic soda is passed through them till the necessary change be produced.

By whatever process it is conducted, when the watering is finished, the plants are dried either by exposure to the air, or by the application of artificial heat. To separate the fibres from the enclosed wood, the plants are subjected to the operation of beating, which is performed either by manual labour with mallets, or on a large scale by means of machinery, and the tender wood being bruised or broken into small pieces, is separated by the operation of heckling. The remaining fibres are then fit for being spun into yarn.

Mr Lee's method.—Beside the colouring matter naturally combined with the fibres of the plant, it can scarcely be supposed that it should not undergo considerable changes in the process of watering; and when this process is carelessly conducted, the fibres themselves are injured in their texture. To obviate these effects, a method of preparing flax was lately proposed by Mr Lee, by which watering, and the consequent injury to the fibres, are avoided. According to Mr Lee's method, the woody part of the plant is broken to pieces by beating the stalks on fluted rollers, and in this way is fully prepared for the operation of heckling. The supposed advantages derived from this method, were, that the fibres are not exposed to any injury, and, according to the rash opinion of a chemist of some reputation, all the processes of bleaching would be completely superseded; but the experiments of many intelligent manufacturers in Ireland, who had adopted this method of managing flax, clearly proved that the fibres were shortened, and thus the fabric of the cloth was injured; and a well conducted series of experiments, under the authority of the Board for the Encouragement of Manufactures in Scotland, shewed, that the produce of flax was considerably less than by the common method. And whatever advantages were derived from Mr Lee's method, the process of bleaching was still found to be necessary.

Colouring matter.—It seems not improbable that a more rigid examination than has yet been attempted of the nature and properties of the colouring matter, might afford the means of improving the bleaching processes. The researches of the indefatigable Mr Kirwan have thrown some light on this subject. When linen cloth is steeped in an alkaline ley, a change is produced both in the cloth and the alkali. The cloth is deprived of part of its colouring matter, and the alkaline properties of the salt disappear. Some new combination, therefore, has been effected. To a portion of alkaline ley thus changed, or saturated with the extract of linen yarn, muriatic acid was added; the precipitate obtained being dried on a filter, became clammy to the feel like moist clay, and assumed a dark green colour; and it was insoluble in 60 times its weight of boiling water. Dried on a sand heat, it became of a shining black colour, and more brittle, but internally it remained of a greenish yellow.

A portion of the greenish precipitate being digested in rectified spirit of wine, was almost entirely dissolved, and communicated to the spirit a reddish hue; but distilled water being added, the solution appeared milky, and a whitish precipitate was formed. The solution of the black matter was conducted in a similar manner, and afforded nearly the same results. Neither spirit of turpentine nor linseed oil, even after long continued digestion, dissolved either the green or the black matter. The green matter communicated to sulphuric and muriatic acids a brownish colour, and to nitric acid a greenish tinge; but no other change was effected, for the quantity of matter was not diminished.

From these experiments it appears that the matter extracted by alkalis from linen yarn is a peculiar resinous substance, but different from pure resins by being insoluble in essential oils, in which property it approaches to the nature of lac. In the farther prosecution of these experiments, Mr Kirwan found that the colouring matter of linen yarn is soluble, either partially or entirely, in solutions of the alkalies, both in their pure state and in the state of carbonate; but that potash, whether pure or combined with carbonic acid, is the best solvent of this resinous matter.

Sect. II. *Operations of Bleaching.*

Steeping.—The first operation to which linen cloth is subjected is steeping; and this may be considered as chiefly preparatory. The object of this process is to remove the paste, or *dressing*, which is applied to the threads in weaving. This matter is separated by fermentation, to promote which, the pieces of cloth are immersed in water, of the temperature of 65° to 75° Fahrenheit, for about 48 hours. Having remained a sufficient time, the pieces are well washed in running water, either by treading with the feet or by means of machinery.

But in the improved process of steeping, the pieces, after being washed for several hours, to separate any loose matters which adhere to them, are introduced into a circular wooden vat, and are regularly disposed above each other, without being too much pressed together. The vat is then filled with the alkaline ley, at a blood heat, which has been employed in the bucking or boiling processes of other parcels of goods; and, to keep the whole immersed in the liquid, a piece of wood in form of a cross is fixed above them. A few hours only elapse when the temperature is increased, the liquid is enlarged in bulk, an intestine motion takes place, air is evolved, and a thick scum is formed on the surface. The period of fermentation varies from twelve to eighteen hours, according to the temperature of the air. But as soon as it ceases the linens must be removed, otherwise they are apt to be injured from the effects of the putrid fermentation which follows, and the colouring matter is at the same time more strongly fixed. The goods are then subjected to a second washing, to separate all the loose matters which adhere to them, and they are then prepared for the operation of bucking.

Bucking.—The next operation, after steeping and washing, is what is technically called *bucking*, and is one of the nicest processes in the art of bleaching. In this operation, the goods are introduced, as in the former, into a large wooden vat; and, from a boiler placed above the vat, the linens are covered with caustic alkaline ley at a blood heat. The ley having remained for some time on the goods, is let off by a stop-cock at the bottom of the vat into an iron vessel sunk in the ground, from which it is pumped up into the boiler, where the ley is raised to a higher temperature, and is again admitted to the goods in the vat, and from the vat it is let off into the iron vessel, and again raised by the pump to the boiler. The same series of operations is repeated till the alkaline solution is fully saturated with the colouring matter, and is also deprived of its causticity. This change is easily ascertained by the offensive smell which it assumes.

In this process it is of great importance, for the complete separation of the colouring matter, to attend to the gradual increase of temperature of the alkaline solution in its repeated applications to the goods: For when, by ignorance or mismanagement, the first application is made at the boiling temperature, the colouring matter, instead of being removed, is so strongly fixed that no after treatment can produce the desired purity.

Another necessary precaution, in concluding the operation of bucking, is to avoid washing the linens in cold water while they are hot, because a portion of the colouring matter is again fixed in them, which is not easily removed. To obviate this inconvenience, a stream of warm water is passed upon the goods, immediately after the saturated alkaline solution is let off. The soluble impurities are thus removed, after which a current of water is allowed to flow on the goods till it pass off nearly transparent. They are then washed and prepared for the succeeding operations.

The improvement proposed by Widmer in France, and varied by Mr Lowrie of Glasgow, in the operation of bucking, has greatly contributed not only to the economy of labour, but also to the saving of the materials employed, especially when it is conducted on a large scale. When the linens are introduced into the vat, and the boiler is filled with the alkaline solution, a pump moved by machinery raises the solution to a sufficient height above the vat to pass through four pipes pierced with small holes, or to fall on a broad plate of metal, through the perforations of which it is equally spread in a continued stream on the goods, and, by means of a valve which opens inwards, the ley, after having passed through the linens, returns to the boiler. As soon as the operation commences the fire is applied to the boiler, and the alkaline solution is gradually heated during its circulation through the goods in the vat, and when it begins to boil the operation of pumping is stopped by detaching the handle of the pump from the machinery, and the ley being forced from the close boiler through the pump, falls in a continued stream on the goods in the vat. The advantages of this improvement are obvious; as the operation is conducted by means of machinery, no danger arises from the inattention of the workmen; the gradual increase of temperature, and regularly repeated application of the alkaline ley, are more effectual in removing the colouring matter; and the quantity of alkali saved is estimated at one-fourth, and sometimes even one-third, of what is required in the former mode of conducting the operation.

Souring.—According to the older mode of bleaching, the process to which linen goods were next subjected was that of *souring.* The linens were steeped in milk which had become sour by spontaneous decomposition. This usually took place for the first time after the fourth or fifth bucking, and was called the first sour, when the whole operations of bleaching consisted of bucking, washing, and crofting, or exposing the goods on the grass. In this first sour the linens remained for two or three weeks, or till it was observed that the scum on the surface began to crack and subside. They were then subjected to a repetition of the other operations.

But as the acid obtained from the milk, or from the fermentation of farinaceous substances, was of uncertain strength, and at best produced but a feeble effect, the introduction of sulphuric acid, the strength of which could be exactly regulated, contributed essentially to the improvement of this operation, and to the abridgement of the time requisite to whiten goods for the market. By this improvement linens could be completely bleached in three or four months, which by the former method required seven or eight months; in proof of which it is only necessary to state, that the souring process, when sulphuric acid is employed, can be completed in eighteen or twenty-four hours, which, in the other method, was less effectually performed in four or five weeks.

In preparing the acid liquor, the sulphuric acid is introduced into a large wooden vessel lined with lead, and diluted with water till it is reduced to the strength of good vinegar. But the proper degree of strength is precisely ascertained by the use of the hydrometer. As the specific gravity of the acid is much greater than that of the water, the precaution should be observed of mixing them well together by agitation before the goods are immersed. When the steeping process is completed, the linens are drained, and carefully washed in pure water, that every part of the acid may be removed, otherwise they are apt to be injured when they are dried, because the water with which the acid is diluted is evaporated, and the acid remains behind and acts on the vegetable fibre.

Whatever effect the application of acids may produce in the bleaching process, whether they combine with the alkali, or with iron, or with some earthy matter, and thus form neutral salts, which are removed by washing, it is certain that there is no good bleaching without their use. A strong prejudice has indeed prevailed against the employment of acids, and it has received some support from the opinion of speculative chemists; but these are fully counteracted by the observation and experience of the practical bleacher, and a fair comparison of the state of the goods soured with the mineral or vegetable acid. It is well known that the omission of the use of acids to neutralize the alkali employed in the bucking operations, subjects the goods to injury when they are exposed to the rays of the sun. This effect never fails if they are laid on the grass, even after a single operation, without souring; and that part of the cloth thus corroded is called by the workmen *ley-burnt.*

Boiling.—In bleaching linen goods, boiling is employed when they are considerably whitened; the ley employed in this operation is made with pearl ashes, or with pearl ashes and a certain proportion of soap. In conducting this operation, a moderate heat should be applied; violent ebullition should be avoided, and the precaution should be observed of keeping the stuffs immersed in the liquid, that its action may be equal and uniform. Cast-iron boilers are used in the boiling operation, and they are furnished with a stop-cock at the bottom, for the purpose of letting off the waste ley.

Sect. III. *Of Bleaching with Oxymuriatic Acid and its Compounds.*

The discovery of oxymuriatic acid by Scheele, in 1774, forms one of the most remarkable eras in the history of bleaching. But although its property of destroying vegetable colours was observed by that eminent chemical philosopher, the application of this active substance to the art of bleaching was not known till ten years afterwards, when the subject was successfully investigated by Berthollet, and its importance in bleaching was fully established. Chaptal, whose labours in the application of chemistry to the arts of life have developed the nature of many important processes, directed his attention to ascertain the properties and use of oxymuriatic acid in bleaching, about the year 1787; and about the middle of the same year, in consequence of a communication from Professor Copland, of Marischal college, Aberdeen, who had witnessed experiments with it at Geneva, to Messrs Milne, of the house of Gordon, Barron, and Company, Aberdeen, they seem to have been the first who employed it in bleaching in this country. But although they were fully satisfied of its efficacy and safety, they limited its use to the bleaching of such goods as the demands of the market did not permit to be subjected to the usual more tedious processes.

In the succeeding year, Dr Taylor of Manches-

Of Linen.

ter, in conjunction with Mr Cooper of the same place, instituted a most decisive experiment to ascertain the use of oxymuriatic acid in bleaching; for by its application an entire piece of cotton cloth was bleached, printed, and prepared for the market in less than three days. The favourable result of this experiment led to the establishment of an extensive bleaching concern near Bolton in Lancashire. In 1789, a detailed account of the construction of the apparatus for preparing the new bleaching liquor, and the mode of applying it to use, was published by Berthollet; and the practice of chemical bleaching was then followed in different parts of France. As it frequently happens in the application of new substances, where even the most cautious observer is apt to overlook some circumstances in the process, many difficulties arose in the first employment of oxymuriatic acid in bleaching. In some cases the cloth was injured; and when the texture remained perfectly sound after the bleaching was completed, it assumed a yellowish shade after an interval of some weeks. But by care and attention in its application, the safety of the fabric was completely preserved; and the alternate use of the acid and alkaline solutions produced a perfect and permanent white. This is to be understood of bleaching cotton goods; for the yellowness of linen cloth can only be removed by exposing it for some time on the grass.

The celebrated Mr Watt of Soho, when on a visit in France, having seen the experiments with the new processes repeated by Berthollet, introduced this method of bleaching into the extensive establishment of his friend Mr Macgregor, at Glasgow; and in the first attempt 500 pieces of goods were finished.

The first application of the oxymuriatic acid was in the state of gas, and the first useful combination of that substance, for the purpose of bleaching, was with potash. This compound was first prepared by a company at Javelle near Paris, and hence it was denominated ley or liquor of Javelle; and it was announced as having the property of bleaching cloth by immersion for a few hours only. Some of the partners in this concern, with the hope of encouragement for the manufacture, settled at Liverpool, and applied to Parliament to secure to themselves the right of the invention. They failed in their application, on the ground that the discovery was not new. The manufacture was continued for some time; but as it was inconvenient to carry it to a distance in the liquid form, and as it was besides subject to a diminution of its strength by the action of the light and air, the demand gradually ceased, and the establishment was finally abandoned. Mr Foy, one of the operators in the manufactory, proposed to the principal bleachers for a suitable premium to assist them in the construction of the requisite apparatus, and to instruct them in the preparation of this liquor for themselves, and by his means the use of oxymuriate of potash became pretty general. Mr Tennant of Glasgow proposed oxymuriate of lime as a substitute for the compound with potash, and, in the year 1798, obtained a patent for this new bleaching liquor, the cheapness of which offered a material advantage to the manufacturer; but being in a liquid form the objection to the carriage of a bulky commodity was not removed. To obviate this objection, the right of preparing the liquor at their own works was communicated for a stipulated premium, and the new method of bleaching became still more general; but the validity of the patent was afterwards disputed, and, after a legal discussion, it was set aside. Mr Tennant's right to the advantages from the preparation of the oxymuriate of lime in the solid form, it is proper to observe, remains entire.

Preparation of oxymuriatic acid.—In the preparation of oxymuriatic acid for the use of the bleacher, various proportions of the materials employed have been recommended. In explaining the construction and principle of the apparatus for its distillation, Berthollet proposes six ounces of black oxide of manganese, one pound of common salt, and 12 ounces of sulphuric acid, diluted with an equal quantity of water. Bleachers in general employ a redundant proportion of materials, the reason of which perhaps is, the inequality of their strength or properties. The most common proportions for the production of this acid in this country, are equal parts, by weight, of sea salt and manganese, which are either carefully mixed together, or, with the addition of a little water, brought to the consistence of a thick paste. The quantity of sulphuric acid employed is equal to the weight of the other materials, and it is diluted with its bulk of water. When it is cool, it is poured upon the salt and manganese which have been introduced into the retort for the process of distillation; but it is supposed that the proportion of some of the materials in this mode of preparing the acid is too great; two-thirds of the sulphuric acid are reckoned sufficient for the purpose, and the quantity of manganese is also superabundant. The proportions recommended by Mr Rupp, are three parts of manganese, eight of common salt, six of sulphuric acid, and twelve of water; but Mr Tennant proposes equal parts of manganese, salt, and sulphuric acid, and the quantity of water to be equal to the bulk of the sulphuric acid. This, however, it is obvious, must depend on its strength. In Ireland, six parts of manganese with the same quantity of common salt, and five parts of sulphuric acid, diluted with five parts of water, are the most common proportions.

Oxymuriate of potash.—The combination of oxymuriatic acid with potash, which was effected by Berthollet about the year 1788, and by Mr Higgins of Dublin about the same time, was an essential improvement in the application of oxymuriatic acid to the purposes of bleaching. It is somewhat slower in its operation, but its effects are not less certain, and the manipulations of the workmen, in consequence of its offensive smell being obviated, are far less disagreeable. The following are recommended as the proportion of the ingredients for the prepara- of this saline compound: A receiver of sixty gallons capacity, English wine measure, is filled with a solution of caustic potash whose specific gravity is about 1015; a mixture of seven pounds of black oxide of manganese, and ten pounds of common salt, is brought

2

to the consistence of thick paste with the addition of a little water, and, being intimately incorporated, is introduced into the retort of the distilling apparatus. The head of the retort is then secured in its place. Eight pounds of sulphuric acid are gradually diluted with an equal weight of water; and when the mixture cools, one half of it is poured into the retort by means of a leaden funnel, through a small opening, which is immediately secured by a plug of lead, to prevent the escape of the gas, which is copiously evolved the moment that the diluted acid comes in contact with the mixture of salt and manganese. The sulphuric acid combines with the soda of the common salt, the muriatic acid is set free, and, according to the older chemical explanation of these changes, unites with the oxygen of the manganese; and in the form of oxymuriatic acid gas, as it passes through the solution of potash in the receiver, enters into combination with the alkali, and produces the oxymuriate of potash. It is usual to commence this operation in the evening; and in the morning when the distillation diminishes, the remaining half of the diluted sulphuric acid is introduced, an increased evolution of gas takes place, and when it again falls off the temperature is increased by means of a water bath; and when the process is finished, the solution of oxymuriate of potash is drawn off from the receiver, and applied to use.

Oxymuriate of lime.—Mr Tennant's patent for the preparation of liquid oxymuriate of lime being set aside, as already noticed, that solution is usually prepared by the bleachers themselves, the proportions of the materials originally directed by Mr Tennant are, 30 pounds of common salt dissolved in 140 gallons of water, wine measure, the object of which is to increase the specific gravity of the water, and the solution being completed, 60 pounds of quick lime in the state of an impalpable powder are added; 30 pounds of oxide of manganese, well incorporated with an equal weight of common salt, are introduced into the retort, and 30 pounds of sulphuric acid, previously diluted with 18 pounds of water, are poured upon the mixture. The distillation is conducted in the usual way, but it is recommended that the contents of the receiver be constantly agitated, to prevent the lime from subsiding.

But the preparation of oxymuriate of lime in the solid form, for which Mr Tennant still retains the exclusive privilege, is another essential improvement, because it can be conveyed to a distance at a trifling expence. When it is applied to use, the concrete compound is dissolved in water by agitation, and any insoluble matter contained in the lime is allowed to fall to the bottom, and the liquor to become transparent. Before it is applied to the purpose of bleaching, it is still more diluted with water.

The application of oxymuriatic acid gas, in combination with potash or lime, to the purposes of bleaching, is attended with very essential advantages; for although the process be less rapid, yet its gradual effect in destroying the colouring matter and whitening the goods is not less effectual, while at the same time it is neither offensive nor injurious to the workmen who are engaged in the business, or to those who superintend the operations.

Oxymuriate of magnesia.—This compound has been found highly beneficial in bleaching the white grounds of printed cloth, and at the same time retaining the different shades of colour unimpaired. In preparing the oxymuriate of magnesia, the earth being reduced to as fine a state as possible, is diffused in water and put into the receiver of the apparatus which is usually employed in the distillation of oxymuriatic acid. One part of manganese is introduced into the retort, and two parts of muriatic acid, of 1200 specific gravity, diluted with an equal bulk of water, are poured on the manganese; the operation commences, and the oxymuriatic acid gas, as it passes off, combines with the magnesia, which is kept diffused in the water of the receiver by occasional agitation; when the process ceases, and the insoluble impurities have subsided, the transparent liquor is drawn off.

Strength of bleaching liquors.—In extensive bleaching establishments, where the consumption of expensive materials, even by the most careful management, is very great, economy in their use must always be of great importance. It is also a matter of no small consideration to bring the substances which are employed in the different processes to the requisite degree of strength, to avoid, on the one hand, an unnecessary waste of labour by a repetition of the operations, and to obviate any risk of injury to the texture of the stuffs to be bleached. The strength of simple alkaline solutions may be ascertained with sufficient precision by determining their specific gravity by means of the hydrometer; and all that is necessary in the application of the alkaline leys, that they may produce their full effect, is to render the alkali employed as caustic as possible, and then to reduce it to that state of dilution which the particular stage of the process requires. The same remark is equally applicable to the strength of the souring liquor, particularly when sulphuric acid is employed.

But in using some of the compounds of oxymuriatic acid, the test of the specific gravity is not equally to be depended on, because, from the complicated action of the different ingredients in the compound, new substances, which indicate the same specific gravity in the solution, make their appearance, and produce very different, and often injurious effects on the stuffs subjected to their operation. In ascertaining the strength of the solution of oxymuriate of lime, the test of the specific gravity as it is indicated by the hydrometer is not alone to be trusted, because a solution of muriate of lime may have the same specific gravity, and not only produce a feeble effect in the bleaching process, but may be actually injurious; for it has been found by experiment, that the fabric of linen cloth boiled in this solution is greatly impaired. Beside the specific gravity, therefore, the property of the solution in discharging vegetable colours must be attended to. To ascertain the proper degree of strength, a solution of indigo in sulphuric acid is employed. In preparing this solution, one part of the indigo, reduced to a fine powder, is digested for several hours on a water bath, with eight parts of concentrated sulphuric acid; when the solution is completed, a thousand parts of water are added. One measure of this solution is introduced into a graduated glass tube, and the bleaching liquor, whose strength is to be ascertained, is poured in till the colour entirely disappears. In this way the number of measures of the bleaching liquor requisite to destroy the colour of the indigo is determined; and when the effect of any bleaching liquor on cotton or linen goods has been ascertained by experiment, and when it is known at the same time what number of measures of the same liquor is necessary to destroy the colour of the solution of indigo, the artist can always command a simple test to regulate the preparation of his liquors at any determinate strength. An improvement of this test has been proposed by Mr Rupp, who employs an acetate of indigo, which is prepared by adding a solution of acetate or sugar of lead to a solution of indigo in sulphuric acid, as long as any precipitate is produced. The sulphate of lead, which is insoluble, falls down, and the acetate of indigo which remains in solution, is poured off and preserved for use. An infusion of cochineal is employed by some for a similar purpose.

Bleaching with oxymuriate of lime.—When oxymuriate of lime is employed in bleaching linen goods, they are subjected to the same preliminary operations as in the old method. The bucking operations are carried on to the fourth or fifth time; but instead of crofting or exposing the goods on the grass for a certain time between each bucking operation, they are subjected to washing with abundance of water. They are then immersed in the solution of oxymuriate of lime; and after being washed with pure water, they are introduced into the souring vessels, again washed in water, and afterwards boiled in the alkaline solution.

For linen goods, three immersions at least in the solution of oxymuriate of lime are necessary. These immersions are followed by the alternate operations of souring and bucking, and between each of the individual processes the goods are to be well washed in water.

When linen stuffs are bleached by this method, they assume a yellowish colour, for the removal of which it is necessary to expose them to the air for a few days. The last operation to which they are subjected is boiling for a short time in a diluted solution of pearl-ashes and white soap. This operation is not only necessary for finishing the goods, but tends to destroy the disagreeable smell which usually adheres to those stuffs which are bleached by oxymuriatic acid, or any of its compounds.

Sect. IV. *Bleaching by Steam.*

Bleaching by steam, which, it is said, has been long practised in eastern countries, was first proposed by Chaptal in a memoir published in 1801, a translation of which soon after appeared in our own periodical works. This method was tried near Paris and in Ireland about the same time. M. Bawens, the proprietor of the manufactory of cotton thread and stuffs, near Passy in France, made the first trial on 1500 ells of cloth intended for printing; and the result of the experiment proved highly satisfactory. The following directions for the management of this operation were given by Chaptal. The cotton, disposed in handfuls, is first impregnated with a weak solution of soda which has been rendered caustic by lime; the cotton is trod down in a wooden or stone trough containing the alkaline liquor; and when it is uniformly penetrated, it is piled up on a wooden grate within a copper boiler; the redundant liquor flows through the bars of the grate into the boiler, and forms a stratum of fluid, which allows the mass to be heated, without any risk of burning either the cotton or the metal of the boiler. This arrangement being made, the apparatus is closely shut up to prevent the escape of the steam. The fire in the furnace is lighted, and the heat is continued till the whole of the liquid in the boiler has been converted into vapour, the temperature of which, from its compression in close vessels, is higher than that of boiling water, and produces a proportional effect in whitening the cotton. After being exposed to the steaming process, which in some cases is continued for thirty-six hours, the cotton is carefully washed, and exposed on the grass for a few days, when it assumes a great degree of whiteness; but if any coloured portion remain, a repetition of the steaming operation, and of exposure to the air, removes it.

This method of bleaching is not confined to cotton goods. A very successful experiment was made, at the suggestion of Chaptal, at the manufactory of M. Bawens, when 200 pairs of linen sheets, from the hospital of Hotel Dieu, were scoured and whitened. In the first experiment, 130 sheets were impregnated with an alkaline ley, containing one hundredth part of soda, were exposed for six hours to the action of the steam, again impregnated with the alkaline solution, and exposed for six hours more in the steaming apparatus. The same operation was repeated a third time; and the clothes being rinsed in water, with the addition of a small proportion of soap, were completely freed from every kind of spot or stain, and appeared of a pure white colour. In a second experiment, a smaller proportion of soda was employed, but with the addition of soap; and the cloth being treated in the same way the results were still more satisfactory. The advantages of this method appeared very considerable, both with regard to the saving of time and expence. By numerous trials which have been made in bleaching goods by this method since it was first announced, it has been found, that five steepings in the alkaline solution, with the alternate operation of the steam-bath, are sufficient for bleaching cotton goods; but nine steepings in the alkaline ley, with the same number of steaming operations, are requisite for whitening linen stuffs. It has been properly suggested, that the method of bleaching by steam may be essentially aided by an occasional immersion of the goods in some of the compounds of oxymuriatic acid. The objection which has been started against bleaching by steam, from the danger of the apparatus bursting by the elastic force of the confined vapour, is not worthy of any attention. To what dangers are not workmen exposed in a thousand other operations, which are not less hazardous when the proper precautions to avoid injury are not observed.

It appears somewhat unaccountable, that after the detailed description of the mode of bleaching by steam, which was published both in the French and British periodical works, and the distinct view of the whole process which is given in O'Reilly's Essay on Bleaching, a patent was granted, after the lapse of a few years, to a bleacher in Dumbartonshire in Scotland, for the exclusive right of a process exactly similar.

Chap. II. Of Bleaching Cotton Stuffs.

The colouring matter which adheres to cotton when it is obtained from the plant on which it is produced, seems to be somewhat of an oily nature. This greasy matter is removed by steeping it in a weak alkaline ley, and afterwards washing it well in running water. But however perfectly the washing is performed, a small portion of earthy matter still adheres to the fibres of the cotton. This matter is easily removed by the use of a diluted solution of sulphuric acid in water, and an after washing in pure water to remove the redundant acid.

Sect. I. *Of Bleaching Muslin.*

The coarser kinds of muslin, after steeping and washing, are boiled in a weak solution of pearl-ashes, and after a second washing they are twice boiled with soap alone; they are then subjected to the souring operation; and after being well washed, to remove the whole of the acid, they are again boiled in soap, and after another washing, they are immersed in a solution of oxymuriate of potash. The boiling in soap, and the immersion in the oxymuriate of potash, are again repeated, until the goods have acquired the requisite degree of whiteness, when they are last of all soured, and washed in pure water. The same processes are followed in bleaching the finer kinds of muslin, excepting that soap only is employed in the boiling operation, because the pearl-ashes are apt to injure the texture of the cloth when it is of a very fine fabric.

Coloured goods.—In bleaching cotton cloths, in which fixed colours, such as turkey red, or indigo blue, are dyed in the yarn before it is manufactured into cloth, much precaution is necessary; and before the effects of the different ingredients were understood by the practical bleacher, no small degree of uncertainty prevailed in the result of the processes to which the goods were necessarily subjected. Cotton stuffs which have permanent colours are first steeped and washed in cold water, and after being boiled with soap, and a second washing, they are immersed in a solution of oxymuriate of potash of moderate strength; the same processes are repeated till a pure white colour is obtained, and the operation is finished in the usual way by souring and washing. In this manner, by proper management of the different operations, the colours are so far from being injured, that they are greatly improved in delicacy and brilliancy.

Ginghams, or other stuffs of which the yarn of the white part has been previously bleached, require fewer operations; after being steeped and washed, to remove the paste or dressing, they are again washed and slightly boiled with soap, rinsed in pure water, soured, and washed.

Drying muslin.—In extensive bleaching establishments much inconvenience and delay arose in bleaching large quantities of muslin, especially in the winter season, and when the time for finishing them for the market was limited, from the want of sufficient means for drying the goods. An ingenious contrivance of Mr Burns of Paisley completely obviates this inconvenience, and enables the manufacturer to bring his goods to the market at all seasons of the year, however unfavourable may be the state of the weather. Mr Burns's discovery consists in the elegant application of a beautiful chemical process, in which great dispatch and perfect safety to the goods are happily combined. The apparatus for conducting this operation is equally simple as the process itself. Hollow cylinders of tin plate are prepared, of such a length as to correspond with the breadth of the cloth to be dried, the pieces of muslin are rolled upon these cylinders, which are then filled with the vapour of water, and are so contrived that the escape of the steam is precluded. The chemical reader will be at no loss to perceive the change which takes place, and the effect of this fortunate application of science to the purposes of art. The large proportion of heat which retains the water in the state of vapour, is given off to the cylinder, and the wet cloth which is wound upon it. The moisture of the cloth is converted into vapour, and is driven off, or, in other words, the cloth is dried. Deprived of its heat, the steam or vapour confined within the cylinder returns to the state of water, and the temperature of the apparatus is consequently diminished; and when this happens, the water is let off, and the cylinder is charged with a new portion of steam.

Sect. II. *Bleaching Cloth for Calico Printing.*

In bleaching cloth which is to be printed, a less pure white is required, but at the same time the stuffs must be perfectly freed from the colouring or other matter, which would prevent the goods from receiving and retaining the colours with which they are to be printed. The alkaline ley in which the stuffs are to be bucked, should be made moderately caustic by means of quicklime, that the fabric of the cloth may sustain no injury, and the solution should remain at rest for some time till it become quite transparent; for if any particles of lime remain in it, and be fixed on the cloth, the colour of those parts which are to be left white never retains the requisite clearness.

When linen cloth is to be prepared in this manner for printing, ten or twelve bucking operations with the alkaline ley are necessary. Between each operation it is well washed, and exposed for some time on the grass; at the end of the sixth bucking it is immersed in the souring liquor, and the same process is repeated as the concluding operation, when it is supposed to be sufficiently white for the purpose of printing.

Test of bleaching for calico printing.—It is extremely convenient for the manufacturer to have an easy test, which enables him to determine when the cloth is sufficiently bleached for printing. This is easily ascertained by cutting off a small stripe from the end of one of the pieces, and printing with the mordant which is to be employed in fixing the colour. It is then allowed to remain for some time that the mordant may adhere to the fibres of the cloth, after which it is well washed to remove the redundant particles, and then introduced into a weak madder bath, the heat of which is gradually increased, and the cloth is alternately immersed and exposed to the air, till the depth of shade required be obtained. If the bleaching process be properly conducted, that part of the cloth to which the mordant was applied combines with the colouring matter of the madder; but if those parts of the cloth which are intended to remain white assume a faint red hue, the bleaching process is imperfect and must be resumed.

As in other cases the bleaching of cotton cloth for calico printing is a less tedious operation, the same processes are followed, but a less quantity of materials is employed in the solution; five or six bucking operations are generally sufficient, and the same test to ascertain the perfection of the bleaching may be adopted.

In Lancashire the boiling is usually continued for eight or ten hours; and the same process, with the intervention of thorough washing, is repeated two or three times. After the second boiling, some bleachers subject the goods to the souring process, while others defer it till after the fourth or fifth boiling. In repeating the boilings, the strength of the alkaline ley is diminished at every succeeding operation. The cloth is then exposed on the grass for two or three days; but as a substitute for the exposure, or to abridge the time, it is immersed in oxymuriate of lime for about twelve hours, after which it is soured with sulphuric acid diluted with forty times its weight of water. Careful washing with successive portions of water is then practised, after which the cloth is hung up in the drying-houses, through which a current of atmospheric air constantly flows.

As cloth of a finer fabric is usually employed for printing with finer and more delicate colours, it is found necessary to repeat the boiling process oftener, and generally once or twice more; but the solution of potash employed is still more reduced in its strength for these additional boilings. In some bleaching establishments, where cloth is prepared for calico printing on a large scale, the pieces are subjected to powerful pressure after each process of bucking, souring, or bleaching. In some works the cloth is passed through a pair of wooden rollers, of sycamore or plane tree; and in others, the powerful agency of Bramah's hydrostatic press is employed for the same purpose. By this pressure the remaining liquor is forced out along with the impurities which have been loosened from the fibres of the cloth by the previous process, and all the pieces are brought to a uniform state of dryness.

The method of bleaching calicoes for printing, in some parts of Scotland, is somewhat different; the goods are first steeped in pure water, and then passed through rollers to force out the loosened impurities. After four boilings, for ten or twelve hours each time, in a caustic alkaline ley of the specific gravity, from 1.0127 to 1.0156, and alternate washings, they are immersed in a solution of oxymuriate of potash, of the specific gravity of 1.0625, which is still farther reduced in strength by the addition of twenty-four times its bulk of water. Having remained about twelve hours in this solution, the goods, while yet wet, are sometimes exposed on the grass for two or three days, and after being five or six hours in the souring liquid they are completely washed. After four more boilings, with alternate washings, they are again steeped in the diluted oxymuriate of potash, and being again well washed are passed through the souring liquor for half an hour. The last operation is a repetition of the washing with abundance of pure water, after which the goods are placed in the drying sheds without artificial heat.

Bleaching printed calico.—Those parts of printed cloth which remain white, have seldom that clearness and purity of colour which are required, and must therefore undergo some process of bleaching before it is fit for the market. This dullness is supposed to arise from the previous imperfect bleaching, or from a portion of the mordant adhering to the fibres of the cloth while in the water bath. On account of the delicacy of the colours which are applied to calicoes, powerful re-agents cannot be employed in whitening the unprinted parts. The oxymuriate of lime is altogether inadmissible, because it affects all the colours, and entirely discharges some of them. The oxymuriate of potash, when employed in a very diluted solution, is less active in its effects, but still it diminishes the intensity of the colours. It is therefore a matter of great importance in bleaching printed calicoes, to employ a substance which, without impairing their brilliancy, shall completely clear the white grounds, and also save the time which was formerly required of exposing the goods on the grass. For this purpose the oxymuriate of soda has been successfully employed. The solution is copiously diluted with warm water, and the maddered pieces are introduced into it, and allowed to remain till the white grounds are completely cleared.

The oxymuriate of magnesia has been employed for the same purpose with still better success; for, while the brilliancy of the colours is fully retained, the white ground is thoroughly purified. This compound, the method of preparing which has been already noticed, is dissolved in water raised to the temperature of 165° Fahrenheit, in such quantity as shall just afford a perceptible taste to the solution, which being well agitated, the printed goods, after being slightly browned, are rapidly run over a winch into the copper, and the operation, which usually requires only a few minutes, is continued till the ground is of a pure white. The cloth is then washed in a stream of water, that the adhering particles of the saline compound may not injure the colours. By adding a small proportion of the salt into the solution, the same process may be repeated on other parcels of the printed goods.

Test of good bleaching.—The prejudice which at one time was very strong against the new method, or chemical bleaching, as it is called, is perhaps not yet entirely removed; but beside the advantages in the saving of time and labour, and, in consequence, of the improvement of the processes since its first introduction in the saving of materials, it ought to be generally known, that the actual waste of the cloth itself by the old practice was not less than from 33 to 35 per cent.; but by the new method it rarely exceeds 26 or 27 per cent. This excessive waste, it is obvious, must have arisen from the tedious operations, and from the long exposure on the grass to which cloth was necessarily subjected in the older method of bleaching; but at the same time it must be admitted, that, from carelessness or inattention in the use of the very active substances which are employed by the modern bleacher, the risk of injury to the fabric of the cloth is considerable; while, on the other hand, under the direction of an intelligent superintendant, who is acquainted with the nature and property of the re-agents which he employs, and with the ordinary attention of the workmen, the whole process may be conducted with the utmost safety to the texture of the goods.

But for the satisfaction of the purchaser and consumer, it is extremely desirable to have a certain test of cloth being bleached without injury. A test of this kind is employed by the manufacturers of thread and cotton stockings in England. A thread of a very dark blue colour, or of turkey red, is run along the head of each stocking, and when the bleaching is properly managed, a perfect white is obtained, while the brilliancy of the colour is undiminished; but if the re-agents employed, particularly the oxymuriate of lime, be of excessive strength, the colours are impaired, and the texture of the goods, it is probable, is likewise injured. A test of the same kind has been judiciously recommended for all kinds of goods; and it has been proposed, that a line of coloured thread should be run along the edge of the cloth for this purpose.

Sect. III. *Bleaching of Hosiery.*

The preliminary operation in bleaching linen or cotton stockings, is to free them from the oily matters which are employed in weaving. For this purpose they are scoured in a scalding hot solution of soap in water, and afterwards well washed in pure water, which is to be renewed till all the impurities are removed. They are then boiled in an alkaline ley composed of one pound of American pearl-ash to one hundred gallons of water. After being boiled in this weak solution, they are washed in pure water, and then immersed in the solution of oxymuriate of lime, in the proportion of seven or eight quarts of the liquid, as it is distilled, to twenty gallons of water; and after remaining an hour and a half, or two hours, they are well washed in cold water, again immersed in the bleaching liquid, and again boiled in the alkaline solution. The alternate operations of steeping in the solution of the oxymuriate of lime, and boiling in the alkaline ley, are usually repeated four times, when they are found to be sufficiently whitened. The goods are then steeped in a very diluted sour, composed of sulphuric acid, in which they remain for three hours, and some times for a longer period. When they are taken from the sours, they are washed several times in fresh portions of water, to separate any remains of the acid, which would injure the texture of the fibres were they allowed to become dry before this rinsing operation is thoroughly completed. To obviate any risk of this injurious effect, they are immersed in a hot solution composed of four pounds of white soap and one pound of pearl-ashes dissolved in 150 gallons of water. By this scalding process, as it is called, the offensive odour of the oxymuriatic acid preparation is destroyed, and an agreeable softness is communicated to the fabric of the stuffs. Scouring in soap and water, succeeded by repeated washings in cold water, finishes the bleaching process, which is immediately followed by the operation of what is technically denominated *getting up*. After being immersed in hot water, to which a small quantity of soap and a little indigo have been added, they are again scoured with a stronger solution of soap, from which they are completely purified by another washing in cold water. The coarser kinds of goods of this description are steeped in indigo and water alone; but for hosiery of a finer fabric, a very hot solution of soap, beside the addition of the indigo, is employed; and this application, it is found, both improves the colour and communicates a fine gloss.

Dried completely in a stove, by means of artificial heat, the stockings are introduced into the brimstone stove, and exposed to the action of sulphurous acid gas, produced by the combustion of sulphur, without which operation, when they are laid up for some time, they are apt to assume a yellowish shade; but the precaution should be strictly observed of not subjecting them to the vapours of sulphur in a damp state, lest the condensed sulphurous acid should injure the fabric, or, from the unequal portions of moisture, should not act uniformly, and thus produce clouds or spots on different parts of the surface. The finishing operation of dressing is performed after they are taken from the brimstone stove, by slightly damping with water, and drawing each stocking separately on a stocking-leg board, and either smoothing them by the hand with a hot iron, or subjecting them to a strong press.

Chap. III. Of Bleaching the Materials of Paper.

Soon after the powerful effects of muriatic acid were known, the French chemists and manufacturers applied it to the bleaching of the materials of which paper is composed. The processes adopted for this purpose were necessarily modified, according to the nature of the substances, and the impurities which adhered to them.

Old printed and written papers.—In the preparation of printed paper which is again to be worked up, it is boiled for a short time in a caustic solution of soda, after which it is steeped in a solution of soap and water, well washed, and then reduced to a pulp by the usual machinery.

Old written papers which are intended for the same purpose are immersed in a cold solution of sulphuric acid in water, and after being washed are subjected to the operation of the paper-mill. The action of the acidulated water is more powerful when the temperature is moderately increased.

Bleaching rags.—The bleaching of rags for the manufacture of paper is varied according as they are of a natural brown colour, or have been dyed with some artificial colour. In the first case, the rags are opened or separated from each other, ma-

Of Paper.

cerated in water, steeped in a caustic alkaline ley, and then exposed to the action of oxymuriatic acid, more or less concentrated with an alkali. But when the rags have been dyed or printed of different colours, they are first opened or separated, and then immersed in the oxymuriatic acid solution; and if the colour should not be sufficiently discharged by the first immersion, they are passed through water acidulated with sulphuric acid; and if the process should still be incomplete, a second application of the alkaline, oxymuriatic acid, and sulphuric acid solutions, in succession, becomes necessary.

Bleaching the pulp.—A better method of purifying the materials for the manufacture of white paper was fortunately adopted by the same chemist, in the application of the gas to them in the state of pulp or paste.—Much inconvenience arose to the workmen employed, from the offensive and suffocating fumes of the oxymuriatic acid gas, when it was used in the uncombined state. This inconvenience was obviated by adding a certain proportion of potash, so that a solution of oxymuriate of potash was the bleaching liquor; but another difficulty arose from the cohesive nature of the pulp or paste when it was reduced to that state of minute division which rendered it fit for the fabrication of the paper, for it soon subsided in the bath and prevented the uniform action of the liquid upon every part of the mass. This difficulty was removed by subjecting the materials to the bleaching process, after the texture of the rags was so far destroyed as to separate the fibres, without reducing them to that state of minute division which is necessary before they are worked up. By this management of the materials, paper of a pure white was obtained.

Bleaching of printed or written papers.—Should it be required to bleach printed or written papers without destroying the texture of the leaves, in the first case they may be steeped in a caustic solution of soda, either hot or cold, and afterwards in a solution of soap; they are then arranged alternately between cloths, in the way which the paper manufacturer follows, and are then subjected to pressure. If a sufficient degree of whiteness is not effected by the first operation, the process may be repeated a second, and even a third time, when it appears necessary; and after being dried and pressed, the bleached leaves are applied to the same purposes as formerly.

In bleaching old written paper, with the intention of preserving its texture and again applying it to use, the leaves are steeped in a souring liquid prepared with sulphuric acid. The solution may be either hot or cold, as the condition of the written papers may require. They are then immersed in the oxymuriatic acid solution, and after being dried and pressed are again fit for use.

Cleaning prints, &c.—Prints, maps, and books, are cleaned and whitened by the action of oxymuriatic acid gas, and the safest mode of its application is in the liquid form, but particular attention must be paid to the management of the process and the strength of the solution, that the texture of the paper may not be injured. For cleaning an engraving, immersion in the liquid oxymuriatic acid is all that is necessary, and it is allowed to remain for a shorter or longer time according to the strength of the liquor.

When the paper of a bound book is to be whitened, the leaves must be carefully separated from each other, that the action of the acid may be uniform on both sides; and for this purpose the book is opened, and the boards are made to rest on the edge of the vessel, that the leaves only may be immersed in the liquid. At the end of two or three hours the book is removed from the acid, and carefully immersed in pure water, that every part of the paper may come in contact with it, the whole of the remaining acid may be extracted, and the offensive odour may be removed. With this view, it is necessary to renew the water every hour.

But a more effectual method of whitening the leaves is to unsew the book, and to place the separated leaves in cases formed in a leaden tub, with thin slips of wood or glass, so that the leaves when laid flat are separated from each other by very small intervals. The prepared liquid is then gently poured in that the leaves may not be disturbed, and when they are sufficiently whitened the liquid is drawn off by a stop-cock, fresh water is added, and if necessary renewed, to carry off the remains of the acid, and the leaves are dried, pressed, and again bound up. By this process some valuable books have been effectually cleaned.

Spots of oil or animal grease may be removed by means of a weak solution of potash; and similar spots or stains of wax may be effectually extracted by another method. The paper which is stained with grease, wax, oil, or any other fat body, is first to be gently warmed, and as much of the oily matter is to be removed by means of blotting paper as will adhere to it. A small brush dipped in hot essential oil of turpentine is then gently drawn over both sides of the paper, which must still be kept warm; the operation is to be repeated according to the thickness of the paper and the quantity of oily matter which it has imbibed. The whiteness of the paper may be restored by dipping another brush in highly rectified spirit of wine, and drawing it over the stained spot, and more especially round its edges. By the cautious use of these means, the spot entirely disappears, and the paper recovers its original whiteness.

Chap. IV. Of Bleaching Bees-Wax.

Of Bees-wax

The time of bleaching bees-wax has been also greatly abridged by the discovery of the new method. It was formerly the practice to expose the wax in the form of thin cakes to the action of the air and weather; but the great saving of time renders the use of the oxymuriatic acid preferable.

The simple acid is employed in the bleaching of wax, and the effect is most powerful when it is applied in the gaseous form. A pneumatic tub, well secured with a close cover, to prevent the escape of the gas, is employed for this purpose. This vessel is filled with water, and the wax, which is to be shred into thin pieces, being introduced, a current of the oxymuriatic acid gas is passed through the water, which is to be kept in constant agitation by means of the usual apparatus. This operation is continued for an hour or two, at the end of which time the wax is generally found sufficiently whitened, and being removed from the water it is melted down and formed into cakes.

Chap. V. Of Bleaching Wool.

As wool is an animal production, it contains a large proportion of those elements which enter into the composition of animal matters. The affinity which exists between the different constituents of animal substances, is more feeble than the affinity of the elements of vegetables, so that they are more liable to decomposition by chemical agents; and hence alkalies and acids have a powerful action on animal productions.

Chemical analysis shews, that wool contains carbonate of ammonia and a considerable proportion of oily matter. It is little changed by exposure to the air; boiling water scarcely produces any action upon it; a strong heat reduces it to a state of fusion. Acids have little effect; but the alkalies in their caustic state entirely decompose it, and form soap.

In bleaching wool, it is subjected to two operations; the first is scouring, and the second is sulphuring or whitening.

Sect. I. *Of Scouring Wool.*

By the operation of scouring, the oily matter which is combined with the wool is separated, which is necessary before it can be subjected to the processes by which it is whitened. For this purpose, a mixture of five parts of river or soft water, with one part of stale chamber-ley, is prepared, by boiling for a short time. As the latter ingredient contains a considerable portion of ammonia, the mixture is to be regarded as an ammoniacal solution, the effects of which are less active than those of the other alkalies.

After steeping the wool for a short time in this solution, it is stirred about for a quarter of an hour, or twenty minutes, that the whole of the greasy matter may come in contact with the solution, and be removed. The wool, placed in a basket, is allowed to drain; and the liquid which passes off is returned to the steeping vessel. The wool is then perfectly washed in a stream of pure water, till the water passes off quite clear. The same processes of steeping and washing are repeated until the wool has acquired that degree of whiteness which it is capable of receiving from this operation.

In steeping fresh quantities of wool, as the power of the bath is weakened, it is necessary to add a fresh quantity of the ley. The temperature also may be increased to render it more effectual; but it is necessary, at the same time, to observe caution in this management, for too high a temperature renders the greasy matter difficult of solution, and the wool becomes harsh when too much of the ley is employed. But the openness, elasticity, softness, and whiteness of the wool, afford the proper tests of the process being properly conducted. The loss of weight which it sustains in scouring is sometimes more than fifty per cent.; but the amount of this loss varies according to the nature of the wool, and the impurities with which it is contaminated.

For finer kinds of wool, a more expensive process is followed: A bath is prepared of black soap dissolved in boiling water; and after the wool has been washed in this bath, it is wrung out, and exposed to the air or sunshine to dry. A second scouring is necessary to clear it entirely of the oily matter, before it is fit for combing; and after it has undergone this operation, if a very pure white be required, two or three additional washings are sometimes necessary.

Sect. II. *Of Sulphuring Woollen Stuffs.*

For many purposes a brighter white is requisite than can be obtained by the process of scouring. This is effected by exposing it to the action of sulphurous acid. The operation of sulphuring is generally performed on the woollen stuff when it is in the state of cloth; and it is conducted in the following manner.

The pieces of cloth are arranged on poles in a close apartment, and a quantity of sulphur, in broad flat vessels, is set on fire, and burns gradually in the chamber, which is made so tight that none of the vapour can escape. The fumes of the sulphur, which is now in the state of sulphurous acid gas, penetrate the pores of the cloth, and completely destroy the colouring matter. This operation requires from six to twenty-four hours; and by passing the cloth through a bath in which a small portion of soap has been dissolved, the roughness and harshness which are left by the action of the vapours of the sulphur are removed.

But on examining woollen stuffs whitened in this way, it was found that the effect of the vapour was confined to the surface of the goods. To produce a more perfect and more permanent whiteness, the sulphurous acid dissolved in water is recommended and employed for this purpose. The apparatus which is used in the preparation of liquid sulphurous acid, is similar in its construction to that which is employed in the production of oxymuriatic acid. The most economical method of decomposing the sulphuric acid, for the purpose of obtaining sulphurous acid gas, is to take a quantity of chopped straw, saw-dust, or some similar substance, which being introduced into a matrass, sulphuric acid is poured upon it, and the vapour which is evolved is conducted into a series of vessels with water in the apparatus alluded to. When the water is sufficiently saturated with the gas, it is drawn off into the vessel in which the stuffs are to be immersed. When woollen stuffs are bleached by this method, they are first scoured in a weak alkaline ley, in which the proportion of potash is not more than one pound to fifty pounds of wool, and the temperature of the bath is raised to about 100° Fahrenheit. After scouring, the goods are washed in a warm solution of soap; and when a high degree of whiteness is wished for, a second, and sometimes a third washing in the soapy solution is required before the process of sulphuring is employed. The stuffs are then passed through the bath impregnated with sulphurous acid, and the operation is continued, by means of a winch, till the proper degree of whiteness is obtained. This is usu-

Of Silk.

ally effected in two or three hours at a single immersion. The stuffs are then drained on a table, which is closely covered up with a cloth, to prevent the action of the air on the sulphurous acid, which, by the change produced on it, might injure them; they are then well washed in running water, and some times steeped in water in which Spanish whitening is diffused, with the addition of a small quantity of indigo or Prussian blue, to improve the whiteness.

Chap. VI. Of Bleaching Silk.

Silk is an animal production, which is prepared by the silk worm, for its cover, in that state which precedes its appearance as a perfect insect. It is then said to be in its raw state, and is covered with a yellow varnish, or gum, which renders it rough and hard, and impairs its lustre. Water, even at the boiling temperature, produces no change on silk, and alcohol has no effect upon it; but alkaline leys, of sufficient strength, dissolve it, as well as the yellow varnish with which it is covered.

Sect. I. *Of Scouring Silk.*

In conducting the process of scouring silk, thirty pounds of soap are dissolved in water for every hundred pounds of the silk. To complete the solution the water is kept some time at the boiling temperature; but, before the immersion of the silk, the temperature is reduced to 90° of Fahrenheit; and it is kept at the same degree during the whole of the process. The silks, suspended on rods or frames, are immersed in the liquid, and allowed to remain till the gum is entirely dissolved; and that every part of the stuff may be exposed to the action of the bath, their position should be occasionally changed. They are then wrung out and well shaken, put into coarse linen bags, in separate parcels of twenty or thirty pounds each, and again steeped in a fresh bath, prepared with a small proportion of soap. They are boiled in this bath for two or three hours, and often stirred up with a stick, to prevent the bags from adhering to the bottom of the boiler. The silk is then wrung out and well washed in a stream of water; and if the bleaching be not uniformly perfect, immersion in the bath must be repeated.

Steeping in the lukewarm bath is not required for silks which are to be dyed; the boiling is considered sufficient; but a larger proportion of soap is employed according to the fineness of the colour. For common colours, thirty pounds of soap for every hundred pounds of silk are found to answer; but for the poppy, cherry-red, and some other colours, fifty pounds of soap to every hundred pounds of silk are necessary.

Bleaching by steam.—In the processes of scouring, which have been just described, the silk stuffs are apt to suffer in their texture. To obviate this inconvenience it has been proposed to bleach them by the action of steam. The apparatus for bleaching cotton by the same process is employed. The boiler is filled with a weak solution of caustic soda; the raw silk is placed on the frames, and it is exposed to the steam of the liquid, which is raised by boiling for ten or twelve hours. By the action of this vapour,

2

the temperature of which is about 250° Fahren. the gum of the silk is removed, and the stuff itself is whitened. After washing with warm water, and being well wrung, the silk is again placed on the frames of the apparatus, and subjected to a second steaming. The washing in a large quantity of water is repeated; and, to give softness to the stuff, rinsing in water, slightly impregnated with soap, is employed.

Sect. II. *Bleaching Process.*

Although silk stuffs are considerably whitened by the different operations of scouring now detailed, a brighter lustre is required for most purposes. To produce the most perfect whiteness they are exposed to the action of sulphurous acid, according to the method which is practised in bleaching wool; and in this case also the whitening process, by means of this acid, is conducted by using it either in the state of gas or in the liquid form, and the same apparatus answers the purpose.

Sect. III. *Of Bleaching with Alcohol.*

The method of bleaching silk, without destroying the gum, was long ago proposed by the French. In this process, spirit of wine and muriatic acid are employed. The bleaching liquor is prepared by mixing a pound of alcohol with an ounce of muriatic acid; and the quantity to be prepared in the same proportions should be sufficient to float the silk. The stuff to be bleached is introduced into a glass vessel along with the liquid, and, being closely covered up, is exposed for twelve hours to the sun, or to a corresponding temperature in the shade for double the length of that time. The silk is then taken out, pressed, and again steeped in a fresh portion of the same liquid, and for the same length of time. It is then taken out, pressed, and washed for a few minutes in pure spirit of wine. Placed in a third vessel with pure alcohol, it is kept for twenty-four hours in the sun, or thirty-six hours in the shade, and the alcohol, as it evaporates, is renewed. The silk is then taken out, pressed, and washed two or three times in fresh portions of pure water; and, last of all, it is dried on a frame, upon which it ought to be strongly stretched to prevent its curling.

But as this is obviously an expensive process, in consequence of the high price of the materials, another method has been proposed, by which the alcohol employed may be recovered. This method was proposed by Baumé, a French chemist. In gauzes and some other fabrics of silk, it is necessary to preserve the natural elasticity and stiffness, and at the same time give a proper degree of whiteness. This is effected by destroying the yellow colour of the silk, and at the same time retaining the gum.

By the usual management of the balls, or cocoons of silk, as they are produced by the insect, they are introduced into an oven, and exposed to the temperature of about 158° Fahrenheit, for two hours, for the purpose of destroying the insect before it has time to eat its way through the ball. By this process of baking it was observed, that it was more difficult to wind off the silk, which besides becomes hard, inferior in quality, smaller in quantity, and less susceptible of a fine lustre. To

Of Silk.

obviate these disadvantages, M. Baumé thought of destroying the insect by means of spirit of wine. The cocoons are arranged in a wooden box, in a stratum of six inches deep, and about half a pint of spirit of wine is sprinkled upon them; they are then mixed by the hand, another stratum is placed over the first, which is also sprinkled uniformly with the same liquid. Proceeding in this way, the box is filled, covered up, and allowed to remain for twenty-four hours, during which the heat is increased, and the spirituous vapour destroys the insects, after which the balls are spread out to dry. The spirit of wine which is preserved in glass vessels, or in those of pure tin, or tinned copper, only should be employed in this process. Leaden vessels should never be used, and wooden vessels are apt to tinge the spirit, which communicates a colour to the silk that is not easily removed in the bleaching process.

The cost of the spirit of wine employed in this process, it is observed, is fully compensated by the saving of labour and fuel, and by the greater produce of silk of a superior quality. It possesses, besides, another advantage, that the cocoons in which the insects have perished before being exposed to the action of the spirit of wine, are more easily distinguished, and as they afford a much worse silk, they ought to be separated from the rest.

The cocoons are immersed in water nearly at the boiling temperature, and the silk is then wound off upon a reel. The water employed in silk manufactories, it is properly observed, should be of the purest quality; and the alum which is used in some countries ought to be rejected; for no saline substance contributes any thing to the beauty or colour of the silk, and in many cases it may prove injurious. After the silk is wound upon the reel, and the threads separated, which are apt to stick together at the four places where they come in contact with the arms, which is done by soaking it in warm water for about two hours, and opening the bands upon a pin, and lightly rubbing the coherent parts, it is dried, loosely folded in its original form, and is then ready for the bleaching process.

Method of bleaching.—A stone-ware vessel, of a conical form, of twelve gallons capacity, and having a large opening at one end, with a smaller one of about an inch in diameter at the other end, is employed for the purpose of bleaching silk according to this method. This vessel must be of such a nature as shall not be acted upon by the liquids, and must be entirely free from pores, that no part of the inclosed liquor shall be lost by leakage. To remove the asperities on the inner surface, which might entangle and break the threads, it is to be rubbed and smoothed with pumice-stone; and a cover, of the same material as the jar itself, is carefully fitted by grinding. When this vessel is employed it is inverted; and the smaller aperture, which is then lowest, is furnished with a cork, through which a glass tube, about a quarter of an inch in diameter, passes, for the purpose of drawing off the liquid when the process is completed. A perforated false bottom is introduced within the jar to prevent the tube from being obstructed. The jar is supported by a wooden frame, immediately under which is placed a cask to receive the liquid as it passes off through the glass tube in the several periods of the bleaching operation; and the apparatus is so contrived that the liquor is conveyed through glass tubes to the receiving vessel below, that it may not be exposed to the air, by which part would be dissipated by evaporation.

The proportions of the mixture employed in bleaching silk by this method are, twelve pounds of spirit of wine to three ounces of pure muriatic acid. The silk being disposed in the stone vessel, the liquid is poured upon it, and allowed to remain for twenty-four hours, when it is run off, and clean spirit of wine is poured upon the silk, and repeatedly drawn off till it passes colourless. The silk being allowed to drain, is ready for a second infusion, with a fresh portion of the liquid, composed of the same proportions of spirit and acid; and it remains in this infusion for one, two, or three days, and even a longer period, till the silk become perfectly white. This mixture being drawn off, clean spirit is sprinkled upon the silk, while it is at the same time pressed down with the hand; and when the spirit comes off colourless, an infusion of spirit, without acid, in the same proportion as in the two first infusions, is poured upon the silk; and after remaining for twenty-four hours, the silk is left to drain, when it is sprinkled with a small quantity of pure water, and this is continued till the water passes off colourless and tasteless. To separate the remaining portions of the muriatic acid, the silk is loosely put into a coarse woollen bag, which is still farther secured by means of another bag, and placed in a basket, which is left for five or six hours in a stream of water, or, where this is wanting, water may be pumped upon a cloth cover, and allowed to pass through the stone-jar for the same time, or until no indications of acid appear in the liquid as it drains off.

Recovery of the alcohol.—The expensive nature of the materials employed in bleaching silk by this process, soon suggested the means of recovering or restoring it to a state of purity; and for this purpose two methods have been proposed. In the first method the acid is saturated with potash, to allow the distillation to be performed in a copper vessel, and is lost; and in the second the distillation is conducted with a silver or glass apparatus, which is not acted upon by the acid, and in this way the acid itself is saved.

The first method is considered the most economical in a manufactory. A solution of potash is added to the acid spirit, which is agitated to promote the saturation, which is ascertained by the fluid no longer reddening the tincture of turnsole, or any other test of acids. When the potash is added, strong effervescence, with the evolution of carbonic acid, takes place. The distillation is then to be carried on in the apparatus of copper, and the alcohol obtained is received and preserved in proper vessels. If too much of the alkali shall have been added, the liquor remaining after the distillation is completed may be employed for the saturation of another portion of acidulated spirit. In the view of still greater economy in the process for the recovery of the alcohol, chalk and quicklime were employed as substitutes for the potash. But it was found that the calcareous earth united very slowly or imperfectly with the acid; for when the fluid was very largely diluted with water, the saturation was scarcely completed in five or six weeks.

By the second process, when the distillation is conducted without alkali, glass retorts are charged with the acidulated spirit, and are arranged on the sand-bath in the gallery of a furnace. The first product has little acidity, but the portions which afterwards come off become gradually more acid, and must be preserved in glass or stone-ware vessels. The first liquor which comes over is reddish and turbid. This is rejected, and the receivers are changed. The succeeding product is the colourless muriatic acid, which has a peculiar aromatic odour, somewhat resembling the buds of poplar. The resin of the silk, decomposed by the acid, remains in the retort; the muriatic acid is obtained of diminished strength, but it is in a state of considerable purity, and, if necessary, may be concentrated by the usual method.

When this new process of bleaching silk was announced, numerous manufactories were immediately established in France; but not being aware of the importance of the materials employed being perfectly pure, the proprietors of some of them were subjected to considerable disappointment and loss. The muriatic acid of commerce was found unfit for the purpose, because it rarely happens that the sulphuric acid which is used for disengaging the muriatic acid from common salt is entirely free from nitric acid; so that the purification of the sulphuric acid becomes a necessary preliminary step in the process.

Chap. VII. Miscellaneous Operations.

In extensive bleaching establishments, where large quantities of materials, some of which are expensive, are employed, it becomes a matter of no small importance to be able to recover such as may be applied to useful purposes. In the present chapter, some of the methods which have been resorted to for the separation and purification of the valuable substances which remain after the distillation of oxymuriatic acid, or the preparation of its compounds, may be briefly noticed; to which it may be useful to add a short account of the methods of scouring and cleansing various stuffs, and of removing accidental spots or stains with which they are contaminated. Such extemporaneous processes may be considered as rather connected with domestic purposes than belonging to large manufactories. The principles are the same, but their application is less systematically conducted.

Sect. I. *Residuum of the distillation of Oxymuriatic Acid.*

The substances which remain after the distillation of oxymuriatic acid, have been very generally rejected as useless. As may be supposed, from the complicated action of the ingredients employed, various compounds remain after the process is completed. These substances are chiefly a portion of oxide of manganese which has been added in excess, some sulphate of manganese, and a large quantity of Glauber's salt, or sulphate of soda.

It has been suggested, that the whole mixture might be successfully employed as a glazing for the coarser kinds of earthen ware, to which it communicates a dark brown colour, from the metallic matter which it contains. It has been suggested also that the waste residuum from the preparation of oxymuriatic salts would be a useful application in improving and fertilizing the soil. But experiments, it may be hinted, are still wanting to ascertain its effects in this way.

Sulphate of soda.—To extract the soda in a pure state from this mixture, provided the process were not expensive, would be attended with great advantage; but even the separation of the sulphate of soda, a less difficult operation, would be followed with considerable profit. To accomplish the latter object, the separation of the sulphate of soda, solution and crystallization are the only requisite processes. For this purpose an extensive establishment was begun in Lancashire, which furnishes an immense quantity of these materials, and it succeeded in the production of excellent Glauber's salt; but the prohibition by government of the sale of the residuum put a stop to the operations; so that the bleacher must purify the waste materials for himself, or throw them aside as useless.

Soda extracted.—The decomposition of the sulphate of soda, for the purpose of obtaining the alkali in a separate state, is an object of still greater importance; and with this view attempts have been made by chemical manufacturers. In one of the methods which has been followed for the decomposition of Glauber's salt, one part of charcoal powder, and nine parts of sulphate of soda being well mixed together, were exposed to the heat of a reverberatory furnace; and when the sulphuret obtained by the decomposition of the acid was in a state of combustion, from three to five parts of old iron, reduced to very small pieces, were added. The fusion of the whole gave a black mixture, composed of iron, soda, and sulphate of iron, which being dissolved in water, and filtered through a basket filled with lime, the clear liquid was evaporated to dryness, and the saline substance was calcined in a reverberatory furnace. The farther purification of the soda thus obtained is completed by a repetition of the processes of solution and crystallization.

The decomposition of the sulphate of soda has been attempted by means of carbonate of lime, for the purpose of neutralizing the alkali by saturation with carbonic acid at a very high temperature. Two parts of sulphate of soda, from which the water of crystallization has been driven off, two parts of chalk reduced to fine powder, and one part of charcoal dust, are well mixed together, and subjected to a white heat in a reverberatory furnace; when the mixture is in a state of fusion, it is constantly stirred till the whole of the sulphur is consumed and the flame ceases to appear. The soda is obtained in a state of purity by repeated lixiviation and evaporation in the usual way. But by whatever process the decomposition of this salt is effected, the extraction and recovery of the soda would render the expense of oxymuriatic acid preparations comparatively trifling to the bleacher, and may therefore be considered as an object of considerable importance.

SECT. II. *Of Cleansing or Scouring different Stuffs.*

As coloured stuffs are often contaminated with spots or stains, a double object must be kept in view in purifying or scouring them. On this subject M. Chaptal has thrown out some excellent hints, which, with the aid of a little chemical knowledge, may be highly useful, not only for domestic purposes, but to the manufacturer on a larger scale. In conducting these processes properly, he observes, it is necessary to be acquainted with the nature of the substances which produce stains,--of those by which stains are removed,—of the effects of these re-agents on the colours, and on the cloth itself,—and of the means of restoring a changed or faded spot. Stains or spots on cloths are produced by oily or greasy substances, acids, alkalies, perspired matter, fruits, &c. Some of these, as the oily or greasy stains, are easily distinguished by their appearance, but the effects of others are of a more complicated nature.

Acids communicate a red colour to black, fawn, and violet-coloured cloth, and to the different shades obtained from archil weed, iron, astringents, and to all the blues, except indigo and Prussian blue. By the action of the acids yellows become paler, except the yellow of anatto, which is changed into orange.

The reds which are produced by Brasil wood, logwood, and cochineal, are converted into violet by the alkalies. The greens on woollen cloth are rendered yellowish by their action; yellow becomes brownish, and the yellow from anatto is changed to aurora. The effects of perspired matter on different cloths are similar to those of the alkalies.

The removal of the stains or spots produced by simple bodies on stuffs, is easy and certain. Oily or greasy matters are removed by alkalies, soaps, the yolk of eggs, or some of the fat or absorbent earths; the oxides of iron by the oxalic or some of the mineral acids greatly diluted; stains from acids are destroyed by the action of alkalies; and spots from alkalies disappear by the effect of acids. Fruit stains are removed by sulphurous acid, and still more effectually by the proper application of oxymuriatic acid. But when the stains are of a complicated nature, different methods must be employed in succession for their removal, as, for instance, when any oily matter combined with iron forms a spot on cloth, the greasy matter must first be separated, before the re-agents, which dissolve the iron, can be applied.

Revival of the colours.—It rarely happens that the colours of stuffs which are subjected to the action of the different re-agents employed in the operation of scouring or cleansing, are not in some degree changed or diminished in their brilliancy. Here, therefore, a knowledge of the art of dyeing becomes necessary for the purpose of modifying the means of cleansing stuffs, and at the same time of retaining the colours, or at least of being able to revive those which are injured, and to restore their former intensity. The nature of the colour and of the ingredients by which it was produced, it is obvious, must direct to the proper means for obtaining these ends. If, for example, an alkali be employed to destroy an acid stain on stuffs of a brown, violet, blue, or poppy colour, the yellow spot which remains, vanishes by the application of a solution of tin; the colour of brown stuffs which have been galled, is restored by a solution of sulphate of iron; acids revive the intensity of yellow colours which have been rendered dusky, or brown, by alkalies; acids redden blacks which are produced by logwood; but by the action of alkalies the red spots are converted to yellow, and by means of astringents the black colour is restored. The blue colour of cotton or wool which has been changed, may be successfully revived by a solution of one part of indigo in four parts of sulphuric acid, diluted with water; and the brilliancy of scarlet is restored by means of cochineal and a solution of muriate of tin.

The selection of re-agents requires attention; vegetable acids, as less liable to produce injury, are to be preferred, but the sulphurous acid may be employed for removing fruit stains; for neither the blue of silk, nor the colour produced by astringents, nor the yellow of cotton, is changed by its action. The stains produced by acids are more successfully removed by ammonia than by means of the fixed alkalies; and when it is applied in the state of vapour the action is speedy and effectual, while the colour is rarely altered.

Stains of a complicated nature.—When the spots or stains on stuffs seem to have been produced by compound substances, and when a simple re-agent has no perceptible effect in removing them, compound matters are successfully employed. The following composition has been found very efficacious in such cases: To a solution of white soap in alcohol, add the yolks of four or five eggs, a portion of the essence of turpentine, and some fuller's earth. Mix the whole intimately, and form the mass into balls, which are to be rubbed on the stained spot, moistened with a little water. After washing the spot with clean water the stain generally disappears.

But as washing destroys the lustre of stuffs of a delicate fabric, it may be fully restored by drawing over the washed place, in the direction of the pile, a brush, moistened with water in which a little gum has been dissolved. A sheet of paper, or a piece of cloth, is laid on the stuff, and a considerable pressure is applied till it is quite dry.

Another process.—The following simple preparation is recommended as a useful application in cleaning silk, woollen, and cotton stuffs, without injury to the colour or texture of the cloth: Take a quantity of raw potatoes, and grate them down to a fine pulp over a vessel of clean water. Pass the liquid matter through a coarse sieve into another vessel of water, and let the mixture remain at rest till the fine white particles of the potatoes have subsided. Pour off the clear liquor, and preserve it in bottles for use. The stuff to be cleaned is spread upon a linen cloth on a table, and a clean sponge, dipped in the liquid, is drawn over the soiled parts, and this operation is continued till the stains disappear. The stuff is then to be washed several times in clean water, to remove the loosened impurities, and it is smoothed and dried in the manner directed above.

Two potatoes of moderate size are sufficient for an English pint of water in the preparation of this liquid. The white fecula which subsides may be used as starch or hair-powder; and the coarse pulp which remains in the sieve may be employed in cleansing worsted curtains, tapestry, carpets, and other coarse goods. The application of the liquid obtained in this way has been extended to the purpose of cleaning oil paintings, soiled furniture, and painted wainscoats.

Sect. III. *Extemporaneous Processes.*

The knowledge of chemistry directs to a variety of simple processes for removing spots or stains from clothes, books, furniture, &c.; and as many of the reagents employed for these purposes can be readily procured, and are of easy application, it may be useful to enumerate some of the processes which are most efficacious in removing those spots or stains, or other impurities which are of most frequent occurrence.

Spots of grease, &c.—Spots of grease, which have been recently produced on cloth or paper, into the pores of which the oily matter sinks and spreads, may be often entirely removed by laying the piece of cloth or paper between two folds of blotting paper and applying a hot iron. The grease is melted by the heat, and is absorbed by the paper; and if the whole is not removed by the first application, a clean part of the paper is placed on the contaminated spot, and the operation is again repeated. In some cases a weak alkaline solution may answer the purpose; or where there is any risk of the colours of the stuffs being injured, either by heat or by the action of the alkali, heated spirits of turpentine may be successfully employed. Stains of white wax may be also removed by spirits of turpentine.

Oil paint.—Recent spots of paint are often very easily removed by washing immediately with soap and water. But such as have been allowed to dry, and to remain for any length of time, may be effectually extracted by spirits of turpentine.

Spots of tar or pitch.—The clothes of persons who are on ship-board are apt to contract spots of tar by coming in contact with ropes or other parts of the vessel; and goods which are conveyed by water-carriage are sometimes contaminated with similar stains. Spirit of wine has the property of dissolving tar completely. The spot may therefore be removed by immersion in this liquid. Spots of tar may be also extracted by rubbing the part with olive oil; and in some cases, where the spot has been recently contracted, it may be removed by a hot solution of soap and water.

Ink stains.—The stains of common writing ink on cloth, paper, or wood, may be extracted by means of almost all the acids; but as the vegetable acids can be employed with less danger to the texture of the substance to be purified, they are to be preferred. All that is necessary is to moisten the spot with a solution of oxalic, citric, or tartaric acids in water, and the application is to be repeated till the spot disappear. As the acids produce no effect on printing ink, they may be effectually employed in discharging written characters from books, without injury to the text. But similar stains are effectually removed, and, under proper management, with equal safety, by very diluted solutions of sulphuric or muriatic acids. The vegetable acids which are employed for this purpose are sold in the shops under the name of salt of sorrel and essence of lemons.

Iron moulds.—Stains of iron are produced on cloth either by coming in contact with iron rust or in consequence of the cloth being washed with soap after receiving ink stains. When such stains have not been of long duration, they are easily removed by some of the vegetable acids already alluded to, or by diluted muriatic acid. But when they have continued long in the cloth, the extraction of such stains is a difficult operation, because the changes which they undergo by repeated moistening with water, and exposure to the air, render them insoluble in acids. The previous application of an alkaline sulphuret, and the succeeding washing of the cloth with water, facilitate the action of the acid and the removal of the stain.

Stains of grease and iron.—Clothes which accidentally come in contact with those parts of machinery which are oiled or greased for the purpose of diminishing friction, contract complicated stains, which must be removed by different re-agents. The greasy or oily matter is first to be extracted by the methods already recommended, after which the iron may be removed by the use of some of the vegetable acids.

Spots of wine, &c.—Stains of wine, cyder, and most kinds of fruit, are, in general, easily effaced by means of oxymuriatic acid; a few drops of the liquid used on a fresh stain causes it almost instantly to disappear. Some fruits, such as plumbs, require the process to be repeated. A very easy method of applying the oxymuriatic acid in the state of gas, is to take a table-spoonful of muriatic acid and to pour it on a tea-spoonful of manganese in powder in a teacup, to place the cup in a larger vessel filled with hot water, and exposing the stained spot, moistened with water, to the fumes which arise from the mixture. This operation is to be performed under a chimney, that the offensive vapour may be carried off.

Such stains may also be effaced by means of sulphurous acid, either in the liquid form or in the state of gas; and a very easy and economical method of employing the sulphurous acid gas is to moisten the stained part of the cloth with water, and to expose it to the fumes evolved by burning two or three brimstone matches. Stains on silk may be removed by a similar process, or by an aqueous solution of the same acid.

The reader who wishes to be more fully informed on the subject of bleaching, may consult the works of Berthollet, Pajot de Charmes, and O'Reilly, Chaptal's Chemistry applied to the Arts, Vol. III. and Parkes' Chemical Essays, Vol. IV.

INDEX.

BLEAK, a species of Cyprinus. See ICHTHYOLOGY.

BLECHNUM, a genus of plants belonging to the order Filices and class Cryptogamia.

BLEEDING, the discharge of blood, either artificially produced, or in consequence of injury or disease. See MEDICINE and SURGERY.

BLEKINGEN, a province of Sweden, which stretches along the Baltic nearly seven miles, is about 25 miles in breadth, and is covered in many places with thick forests of oak and pine trees. Carlscrona, which is the capital, Carlsham and Solvitsberg, are the principal towns. The soil of this province is not very susceptible of cultivation; hunting and fishing are the chief occupations of the inhabitants; and their export trade consists of tallow, hides, leather, tar, and timber.

BLEMMYES, a rude people of Ethiopia, who are represented as being deformed in their persons, and whom the fabulous accounts of the ancients described as being without heads, and having their mouths and eyes placed in the breast. But it appears, from authentic history, that this people joined the Egyptians in their opposition to the Romans under Dioclesian, in the third century.

BLENDE, an ore of zinc. See MINERALOGY.

BLENHEIM, a village in the circle of Suabia in Germany, which has become memorable in history in consequence of the total defeat of the French and Bavarians, and the splendid victory of the British and their allies in its vicinity, on the 13th of August 1704. The French army, composed of 60,000 men, was led by marshall Tallard and the duke of Bavaria, two of the most celebrated generals of the age. The British army and the allies amounted to 55,000 men, under the command of prince Eugene and the duke of Marlborough. The battle commenced about nine in the morning, and the cannonading continued for more than three hours. The troops then advanced to the attack, the right wing under the direction of prince Eugene, and the left headed by the duke of Marlborough, and in a short time obtained a most decisive victory. Marshal Tallard, and many other officers of rank, were taken prisoners; 10,000 French and Bavarians were left dead on the field; the greater part of the cavalry perished in attempting to cross the Danube; 13,000 men were made prisoners; and 100 pieces of cannon, with 24 mortars, 129 colours, 171 standards, beside a considerable treasure, fell into the hands of the victorious army, of whom 4500 men were killed, and about 8000 were wounded or taken prisoners. Blenheim is twenty-four miles from Augsburg, eight miles from Donnawert, and two miles from Hochstet, which latter sometimes gives name to this memorable battle.

As a reward for his services, the manor of Woodstock was appropriated to the duke of Marlborough and his heirs, and a grant of L.500,000 was made by Parliament to erect the princely mansion which received the name of Blenheim house, in commemoration of his victory and triumph. Even the tenure by which the manor is held, refers to the same splendid event; for a flag embroidered with *fleurs-de-lis*, is to be annually presented at the castle of Windsor, on the day on which the battle of Blenheim was fought.

BLENNIUS, the Blenny, a genus of fishes belonging to the order Jugulares. See ICHTHYOLOGY.

BLIGHT, an affection of plants, which has sometimes been ascribed to disease, and sometimes to the work of insects, and is particularly incident to grain. See *Wheat*, under AGRICULTURE.

BLIND, an appellation applied to those who are deprived of the sense of sight. For an account of the methods which have been invented and practised for the instruction of those who labour under this unfortunate privation, see EDUCATION.

BLITUM, *Blite, or strawberry spinage*, a genus of plants belonging to the Monandria class.

BLOCK, a frame of wood with one or more pulleys, employed in the management of the rigging of ships, as well as for other purposes, to increase the mechanical powers. For an account of the different kinds of blocks, and of the ingenious machinery which is employed in making them, see SHIP-BUILDING.

BLOCKADE, a term in military affairs, which is applied to a place from which all supplies of men and provisions are cut off by the vigilance of a besieging army, for the purpose of compelling the besieged to surrender without any direct assault; and hence to raise a blockade, is to force the besieging troops to retire from their posts.

BLOIS, a town of the department of Loire and Cher in France, which is finely situated, partly on an eminence, and partly on a plain on the banks of the Loire. The castle, the cathedral, the Jesuits college, the gates of the city, and the bridge over the river, some of which are magnificent edifices, are the principal buildings. The supply of water is furnished by an aquæduct, supposed to be of Roman construction, and from a large reservoir near the walls it is distributed to different fountains. The population exceeds 13,000. The manufactures of serges, gloves, hats, stockings, and some hardware, are considerable; and the principal trade consists of brandy and wines, which are conveyed by water-carriage to Orleans, Paris, and other places of France.

BLOOD, the fluid which circulates through the vessels in the bodies of animals. For an account of which, see ANATOMY.

BLOOD-STONE, a mineral substance, belonging to the Siliceous genus. See MINERALOGY.

BLOSSOM, the flower of a plant, which contributes to the ripening and protection of the seed of the embryo fruit.

BLOW-PIPE, an instrument employed in chemistry and mineralogy, for producing a very intense heat by the flame of a candle or lamp, and thus by an easy process making experiments on small portions of substances, to asertain some of their properties and habitudes. See MINERALOGY.

BLOWING-MACHINE, is an apparatus for forcing air into a furnace with great velocity, for the purpose of increasing the power of combustion, and the rapidity of smelting operations. See FURNACE.

BLUE, one of the seven colours into which a pencil of rays of light is divided by the intervention of a glass prism. See OPTICS.

BOA, a genus of serpents, some species of which acquire the largest size of this tribe of animals.

BOADICEA, a British queen, who is celebrated in history for her brave resistance to the Roman arms. Her husband, the king of the Iceni, bequeathed to his two daughters, and to the emperor Nero, the whole of his dominions and treasures, in the hope of securing to his family and people the friendship and protection of the Roman governor. But, on his death, the Romans seized the whole; and the opposition and remonstrances of Boadicea to their unjust proceedings brought upon her a most barbarous treatment. She herself was subjected to scourging, a punishment inflicted only on slaves, and her daughters were violated. The irritated Britons flew to arms, and, with Boadicea at their head, were determined to shake off the Roman yoke.

To oppose the vigorous efforts of the Britons, the Romans were obliged to collect their scattered forces, and, after a bloody battle, in which success long remained doubtful, victory at last declared in their favour. Dreading the consequences of falling into the hands of her enemies, from whom neither mercy nor generosity was expected, the unfortunate Boadicea destroyed herself with poison.

BOARD signifies a piece of timber which is sawn into thin pieces for various purposes; the same term is applied to a table or bench on which artisans perform their work, as, a work-*board*, shop-*board*; it denotes also a frame on which certain games are played, as, a draft-*board*, a chess-*board*; and likewise an office where public business is transacted, as, the *board* of works, the *board* of ordnance.

Board is also a naval term, which signifies to go into a ship, as when it is said to go on board.

BOARDING is a term in naval tactics, when the crew of one ship, determined speedily to finish the combat, go on board the ship of the enemy, and attack them with small arms.

BOAT, a small open vessel, which is employed in short voyages, and is conducted on the water either by rowing or sailing. Boats are constructed of different forms and sizes according to the purposes for which they are destined. See SHIP-BUILDING.

BOAT, LIFE, a boat of a particular construction, which is well calculated for resisting the violence of a stormy sea, and is thus fitted to afford relief to stranded vessels, and to save the lives of the unfortunate mariners; and from this circumstance it derives the name of life-boat. See SHIP-BUILDING.

BOAT-BILL, a species of bird. See *Cancroma*, under ORNITHOLOGY.

BOATSWAIN, a naval officer, to whose charge is committed the management of the boats, sails, rigging, &c. It is also the business of the boatswain to summon the crew of the ship to their duty, and to attend to the change of the several watches.

BOCCACE, or BOCCACIO, JOHN, a celebrated Italian writer, was the son of a peasant in Tuscany, and was born in 1313. Placed by his father under the tuition of a merchant at Florence, for the purpose of being instructed in the knowledge of commercial affairs, to which his future life was destined, he was fortunate at first in securing, by his industry and fidelity, the approbation of his master; but the charms of poetry, which captivated his fancy, rendered the dull routine of trade irksome; he grew careless in business, and, after six years service, he was dismissed for negligence. The study of law, to which he afterwards directed his attention, was not more congenial to his taste; and having relinquished every plan of life that was suggested or urged by his friends for the pleasures of poetry, he attached himself to Petrarch, and, while he enjoyed his friendship and instruction, his exhausted finances obliged him to share in the bounty of that immortal bard. Boccacio was initiated in Greek literature by a learned native of Thessalonica, who visited Italy; the fame of his attainments spread abroad; and the Florentine republic conferred on him some honorary marks of distinction. Employed in the management of important public affairs, he was charged with the mission of soliciting the return of Petrarch, whom the violence of faction had driven from Florence. But the literary friends preferred quiet and retirement, in security, to honours and emoluments in the midst of bustle and danger.

Having spent several years at the courts of Italy and Sicily in scenes of gaiety and dissipation, he was recalled from a dissolute life by a singular warning from a Carthusian friar, who pretended that he received a commission from one of the holy brothers of his convent, to predict to Boccacio that his life would be short unless he reformed his licentious manners, and corrected the libertine sentiments of his writings. The superstitious mind of Boccacio was strongly impressed by this strange admonition. He abandoned the study of profane authors, entered into the clerical profession, and became more serious and sober in his habits; and having been employed in a diplomatic capacity at the court of Rome, and in other public affairs, he retired from active life, and died in 1375.

The principal work of Boccacio is *Il Decamerone*, a collection of one hundred stories, which are supposed to have been recited in ten days, to which the title alludes, by a party of both sexes, who had retired from Florence while the plague prevailed in that city. This work, which is partly fictitious, and is a severe satire on the practices of the priests, and some of the doctrines of the Catholic faith, met with great applause, and was translated into different languages; but it abounds with licentious sentiments and indelicate descriptions, although, in common with his other prose compositions, the elegance and purity of the style are conspicuous. Boccacio was the author of numerous other works, some of which were written in Latin and some of them in Italian.

BOCCONIA, *Greater Tree Celandine*, a genus of plants belonging to the Dodecandria class.

BOCHART, SAMUEL, a learned French writer, was the son of a minister of the reformed church at Rouen, where he was born in the year 1599, was remarkable for the early maturity of his genius, and is particularly commemorated as the author of Greek verses in his twelfth year. Having completed his philosophical and theological studies at Sedan, Saumur, and Leyden, he was appointed, on his return to France, to the church of Caen in Normandy, and soon after greatly distinguished himself by his learning and acuteness, in a dispute which he maintained in the castle of Caen, in presence of a numerous assemblage of Catholics and Protestants, with Father Veron, a famous itinerant controversialist. The chief work of Bochart is his Sacred Geography, written in Latin, in which he treats of the dispersion of mankind, and of the colonies and language of the Phœnicians. His researches were afterwards directed to the animals, plants, and precious stones mentioned in the Old Testament; and in a separate publication he treats of the animals of Sacred Scripture. While engaged in a dispute at the academy of Caen, in 1667, he was suddenly carried off by a stroke of apoplexy. To his praise it is recorded, that his modesty and humility were equal to his learning and knowledge. His works have been collected and published in three volumes folio.

BOCNIA, a town of Austrian Poland, in the palatinate of Cracow, and twenty miles distant from the town of the same name, is celebrated for its salt mines and the immense excavations which have been formed in them, in the course of many centuries since their first discovery.

BODMIN, a borough town of Cornwall in England, stands in the centre of the county, and from the numerous monumental remains, supposed to be Druidical, in the vicinity, lays claim to great antiquity. With a population exceeding 2000, Bodmin is now remarkable for its wool market and its manufactures of the same commodity, particularly serges. Bodmin is 235 miles west from London.

BOECE, or BOETHIUS, HECTOR, one of the older historians of Scotland, was born at Dundee in 1470, completed his academical studies at Aberdeen, and afterwards at the university of Paris, where he contracted a close friendship with the learned Erasmus; and being recalled to his native country, was appointed principal of King's College, Aberdeen, with a salary of 40 merks, or L.2, 4s. 6d. Sterling. Gratitude for this distinguished elevation, prompted him, it is said, to compose the *Lives of the Bishops of*

Aberdeen, a large portion of which is devoted to his patron bishop Elphinston, the founder of the college. But his greatest work is *the History of Scotland*, from the origin of the nation; a work which has been the subject of much controversy among later historians, defended by some, and charged by others with the detail of events the materials of which are drawn from fabulous tradition. Boethius is highly eulogised by his friend and correspondent Erasmus, on account of the eloquence of his compositions, and the elegance of his language. He died about the middle of the 16th century.

"Boethius," Dr Johnson observes, "may be justly reverenced as one of the revivers of elegant learning. His style, though perhaps not always rigorously pure, is formed with great diligence upon ancient models, and wholly uninfected with monastic barbarity. His history is written with elegance and vigour, but his fabulousness and credulity are justly blamed. His fabulousness, if he was the author of the fictions, is a fault for which no apology can be made; but his credulity may be excused in an age when all men were credulous. Learning was then rising on the world, but ages so long accustomed to darkness were too much dazzled with its light to see any thing distinctly. The first race of scholars in the fifteenth century, and some time after, were for the most part learning to speak rather than to think, and were therefore more studious of elegance than of truth. The contemporaries of Boethius thought it sufficient to know what the ancients had delivered. The examination of tenets and of facts was reserved for another generation."—"In the present age of trade and taxes," continues he, "it is difficult for the imagination so to raise the value of money, or so to diminish the demands of life, as to suppose 44s. an honourable stipend; yet it was probably equal not only to the needs but to the rank of Boethius."

BOEHMEN, Jacob, denominated the *Teutonic Philosopher*, was a noted German visionary, and was born in a village near Gorlitz in 1575. While engaged in the humble occupation of a shoemaker, he had turned his attention to alchemical researches and astrological studies; and, under the influence of fancied celestial visions, he was seized with the enthusiastic raptures of divine illumination. The fruits of his wild reveries appeared in 1612, in a treatise, entitled, *Aurora*, or *The Rising Sun*, which exhibits, in quaint and obscure language, a strange mixture of alchemy, astrology, and divinity. This work brought down upon him the censure of the civil authorities; and it was not till after the end of seven years that he published various other works, and concluded his labours with a key to his writings. The visionary scenes which appeared to his disordered imagination through life continued at his death. Fancying that he heard sweet music, and receiving an answer to his inquiry what was the hour, it is said he replied that his end was fast approaching; and having taken leave of his wife and family, he expired about the time which he had predicted. This fanatical visionary has not been without followers, both in Germany and Britain, and a translation of his works appeared in England.

BŒOTIA, a kingdom of ancient Greece, which is separated from Attica on the east by mount Cithe-ron, has for its boundary on the north Negropont, Phocis on the west, and the gulph of Corinth on the south. This region is watered by numerous streams; the vallies are remarkable for their fertility, and the hills afford rich pasture to flocks and herds. Many of the places in Boeotia are famous in classical antiquity, among which may be noticed Aulis, a seaport town on the strait Euripus, where the confederated heroes of Greece assembled for their successful expedition against Troy;—Thermopylæ, at the straits of which Leonidas and three hundred Spartans fell gloriously in opposing the immense army of the Persians under Xerxes;—the cave of Trophonius, who was consulted as an oracle, and from which, as the fable relates, no person who ever entered it was afterwards seen to laugh;—and the far-famed mount Helicon, the seat of the muses. The ancient capital of Bœotia was Thebes, and hence the inhabitants of the country were distinguished by the appellation of Thebans more frequently than by that of Bœotians.

BOERHAAVE, Herman, the most celebrated physician of his age, was the son of the clergyman of Voorhoût, a village in the vicinity of Leyden, and was born in 1668. He was originally destined for his father's profession, and with this view his studies at the public school and university of Leyden were conducted. During the intervals of his application to literary pursuits, it was his father's custom to employ him in rural occupations, which he continued through life to love and practise. In his 16th year he was deprived by death of his father, who left behind him a very slender provision for a widow and nine children, of which he was the eldest. This affecting loss seemed to present a serious obstacle to the acquisition of a learned education; but with a firm resolution, and a spirit not to be depressed, he determined to surmount the difficulties of poverty, and to supply by industry the want of fortune.

When he took his degree in philosophy in 1690, he chose for the subject of his thesis the discussion of the distinct nature of the soul and body, and he treated it with such accuracy and perspicuity that he successfully exposed the sophistry of Epicurus, Hobbes, and Spinoza, and equally raised the character of his learning and piety. Divinity and its collateral branches of education continued to be his chief employment; in the pursuit of those studies his slender patrimony was exhausted; and being now compelled to depend for his support on his own active exertions, the proficiency which he had made in mathematical learning enabled him to derive some emolument from the instruction of less advanced students in that science.

A strong bias to medical studies now seized his mind. At first he proposed to himself that they should be only an accompaniment to the study of divinity, which he intended as the serious occupation of his future life; and, in following out his new course of study, he made himself familiar with the structure of animal bodies, not only by the perusal of anatomical works, but also by the dissections and inspection of the bodies of different animals. With this preparatory knowledge, he commenced the arduous task of reading the best medical authors, from Hippocrates to his own time.

Chemistry and botany also obtained a large share of his attention. But with these laborious inquiries his theological studies were not neglected; for still he proposed, as soon as he had advanced to a medical degree, to engage in the cure of souls. Having accomplished this end, he returned, in 1696, to Leyden, with the pious design of undertaking the ministry; but he found, to his surprise, that a rumour which prevailed of the tendency of his opinions to the doctrines of Spinoza, or to atheism itself, was a complete bar to the execution of his plan. Prudence forbade him to struggle against popular calumny, and induced him to relinquish all pretensions to ecclesiastical preferment. With new ardour he resumed his medical studies, and commenced the practice of that profession in which he rose to such distinguished eminence. In the beginning of his medical career his encouragement was not flattering, and his circumstances were by no means easy.

But he was resolved to persevere in the plan which he had formed for himself, determined, if success should be his lot, that it should be the reward of diligence and real merit. Declining the most flattering invitations to settle elsewhere, he continued to employ his time in increasing his knowledge, in visiting the sick, and in teaching mathematics. His appointment, in 1701, to teach the institutes of medicine in the university, extended his reputation. His lectures were heard with great applause, and he was invited by his audience to enlarge the original plan of his course, and to instruct them in chemistry; a task which he undertook, and executed not less to the advantage of his pupils, than to the improvement of the science itself. Having continued in these labours for nine years, he succeeded to the professorship of medicine and botany; and in the latter department of his official duty he greatly enlarged the botanical garden, and enriched it with an immense number of new plants. In 1714 he was deservedly elevated to the rectorship of the university; and in the succeeding year, when he resigned that office, he pronounced an oration on the subject of attaining to certainty in natural philosophy, in which, with the true spirit of science, he illustrates the advantages of experimental knowledge, and reflects with just severity on the arrogance of those who are better pleased with constructing hypotheses than disposed to submit to the toils and drudgery of making observations. In 1718, he was chosen professor of chemistry; and in teaching that science was successful in introducing a perspicuity of arrangement, and elegance of style, which were altogether unknown to its former teachers, or to writers on the subject. In 1722, the course of his lectures and his practice were interrupted by a severe illness; but this afflicting event affords ample proof in what estimation this great man was held by his countrymen. The history of his disorder, which was induced by imprudent exposure to cold, can scarcely fail to excite horror in the reader. For five months he was confined to his bed, where he lay upon his back, unable to attempt the slightest exertion without the most excruciating pain, which deprived him, not only of motion, but of sense. A fortunate remission of his illness took place in the sixth month, which was followed by a recovery greatly desired, but at that time little expected; and when he resumed his official duties, the pleasing event was celebrated with general joy and public illuminations. It is not unworthy of record, that, during the many painful days and sleepless nights which he passed during his illness, he found nothing so effectual in filling up the lingering hours, and alleviating his sufferings, as meditation upon his studies, recollection of what he had read, and a review of those stores of knowledge with which his memory was so amply furnished.

In 1727 he was seized with another severe disorder, which became so alarming that his life was despaired of. The return of his distemper became frequent, and the vigour of his constitution was so exhausted that in 1729 he resigned his professorships; but although he lived with less public employment, his life was not spent in idleness. For, beside the time which was occupied for communicating instruction to his scholars, a large portion was devoted to the cases of patients, who either waited upon him personally for advice, or who consulted him by letter from distant places. His last illness commenced in 1737, and although it was lingering, painful, and afflictive, his firmness and constancy, supported by the warmest piety, and the utmost resignation to the divine will, remained unshaken. On the 23d day of September 1738, when he had reached the 70th year of his age, he was relieved by death from all his troubles.

Thus ended the life of this extraordinary man, whose private virtues, extensive knowledge, and distinguished reputation, have been rarely equalled, and never surpassed. His celebrity as a public teacher drew together crowds of pupils from all parts of Europe; and being well aware that his labours would not be less useful if he studied to recommend truth by elegance, he was not negligent of the embellishments of polite literature in his lectures and writings. His temper was cheerful, and he was always desirous of promoting mirth by facetious conversation; never soured by calumny and detraction; cautious of provoking enemies by severity of censure, he never touched on the faults or defects of others, and never inflamed the envy of rivals by obtruding his own merit; modest, but not timorous, and firm without rudeness, he was neither overawed nor depressed by the presence or insolence of the great.

It seems almost incredible that Boerhaave amassed a fortune of more than L.200,000; and on this account he has been charged with excessive parsimony;—a charge which has been repelled, by stating, that the multifarious avocations of his busy life precluded him from the indulgence of expensive luxury; but perhaps it may be more justly alleged, that his simple habits were altogether incompatible with what may be deemed liberal or profuse expenditure. He rose early, commonly at four in summer and five in winter; devoted his morning hours to study, allotted the middle of the day to public business, and occupied the evening in necessary recreation and amusement. In his dress, he was not more distinguished than the plainest citizen; riding, as long as the distempers with which he was afflicted permitted him to enjoy it, was his favourite exercise; and he derived great pleasure from the garden attached to his country-house, which was stored with great variety of all the plants and herbs which were suitable to the climate.

Boerhaave was the author of numerous works on medicine or its kindred sciences. Of these works the Institutes of Medicine, his Theoretical and Practical Chemistry, and Medical Aphorisms, are the most esteemed, and may be read with advantage at the present day. His elaborate treatise on Chemistry has been translated into English, and his Aphorisms have been illustrated by Van Swieten, in a copious commentary of five volumes.

BOERHAVIA, a genus of plants belonging to the Monandria class, which is so named to commemorate the illustrious Boerhaave, who, amidst his other labours, was an assiduous and successful cultivator of Botany.

BOETHIUS, Flavius Anicius Manlius Torquatus Severinus, an illustrious Roman, and author of a celebrated work, *The Consolation of Philosophy*, was descended from one of the noblest families of Rome, where it is supposed he was born about the year 470. He flourished in the time of the emperors Zeno and Theodoric. His early youth was spent at Athens, where he improved himself in the learning and philosophy of Greece; and returning to Rome, soon rose by his talents and virtues to the chief dignities of the state. His illustrious birth and exalted station, did not prevent him from prosecuting those studies which had a tendency to enlighten and refine his countrymen. With this view, he was anxious to make them acquainted with the arts and sciences which had long flourished in Greece; and he translated, and elucidated by commentaries, the principal works of the Greek philosophers. He filled the important office of consul; he was raised to the patrician rank; and when his sons grew up, he enjoyed the rare and singular felicity of seeing them united in the consulship.

In the struggle which prevailed between Theodoric and the senate, some of whose members had determined to resist the growing tyranny of the emperor, Boethius appeared as the eloquent advocate of his friend Albinus; but asserting the liberties of Roman citizens, and claiming the equal protection of the laws, he was involved in the same charge, and the senate, overawed by the power of the tyrant, reluctantly pronounced the sentence of banishment. Immured in the tower of Pavia, and loaded with fetters, he successfully directed his attention to those sources of intellectual enjoyment which the pursuits and studies of his life so amply furnished. Within the walls of his dungeon, and during the awful moments of suspense that preceded his approaching fate, he composed the Consolation of Philosophy, a work which the voice of succeeding ages has pronounced to be not less distinguished by the sublime morality of its views than the elegance and purity of the language. About a year after his imprisonment, this virtuous philosopher was put to death by the orders of Theodoric; and with Boethius, it is said, the Latin tongue and the last remains of Roman dignity vanished in the western world.

The learning and eloquence of Boethius are conspicuous in his works, which were collected into a folio volume, printed at Venice in 1499. Another edition appeared at Basle in 1570. Boethius was one of the chief writers on music among the Romans; but his principal work is his *Consolation of Philosophy*, which has deservedly retained its popularity through every succeeding age; and among its translators are two royal personages, whose auspicious reigns added peculiar lustre to the throne of England, and whose lives, like the author's, had experienced many vicissitudes of fortune. Alfred the Great produced a version of this work in the Saxon language, and Queen Elizabeth, during her captivity before she ascended the throne, translated it into English. The poet Chaucer also executed the same task.

BOHEMIA, a kingdom subject to Austria, which occupies a central situation in Germany, has Saxony and Silesia on the north, Moravia on the east, Austria on the south, and Bavaria on the west; lies between the 48° and the 51° of north latitude, and the 12° and the 16° of longitude east from London; and extends in an elliptical form about 200 miles from east to west, and nearly 150 from south to north.

Physical state.—It has been maintained that Bohemia, at some remote period in the history of this earth, must have been under water, and constituted a great inland sea—an opinion which derives probability from its external appearance; for it is encompassed with high mountains, while the interior expands into an uninterrupted plain, so that the whole assumes a bason-like form. The highest summit of the western range is elevated 3980 feet above the level of the sea; the northern chain rises to the height of 3780 feet; and the ridge on the eastern and southern frontier 2562. The sheltered hollows of these heights are filled with snow during the whole year; in one place some straggling brushwood crowns the loftiest summits; in another, groups of fantastic peaks shoot up from the mingled confusion of shelving precipices and deep ravines. In the neighbourhood of Adersbach, a space, five miles in length and a mile and a half in breadth, is covered with innumerable columnar masses of sandstone rock, in a perpendicular position, which exhibits to the traveller a grand and singular scene, and presents an object of peculiar interest to the geologist.

Rivers.—No stream traverses the great plain of Bohemia that has not its source in her mountains.—The torrents which rush down their steep declivities are numerous and rapid; and many of them, uniting their waters, form large rivers, which cross and divide the flat country. The Moldau which rises on the southern frontier, the Eger which flows from the mountains near Bavaria, and several considerable streams which rise on the northern side, fall into the Elbe, which traverses the whole of Bohemia from east to west; and having opened a passage for itself through the rocks of the Erzgebirge, continues its course across Saxony towards the ocean.

Climate.—Writers have flatly contradicted each other in their accounts of the climate of this country: one assures us that, as neither lake nor marsh pollutes the atmosphere, the climate is dry, temperate, and salubrious; that the heat of summer is neither intense, nor the cold of winter severe; and that Italy itself cannot boast a finer spring:—while another, with equal claims on our credit, asserts, that the air of Bohemia is dense, damp, cold, and consequently unwholesome, and subjects the inhabitants to more epidemical diseases than fall to the lot of those that dwell in the neighbouring provinces. The truth is probably to be sought for between these extremes. Bohemia is a region placed in a temperate latitude, sheltered from the violence of storms by surrounding mountains, and refreshed and beautified by many living streams—circumstances highly conducive both to the health of its inhabitants and the fertility of its soil.

Productions.—In a mineralogical point of view, this country is interesting above most others; its mountains exhibit, in a successive series, every kind of primary and secondary rock. Many varieties of excellent marble are abundant, as well as mines of of all the common metals; and gems are sometimes found which are held in high estimation. The mineral springs of this country, both cold and hot, are celebrated for their medicinal virtues, and are therefore places of great resort. The soil, though in some places light and sandy, is in general rich and fertile, and brings forth abundantly wheat and other kinds of grain, fruits in great variety and of exquisite flavour, flax and hemp, hops and timber. Nor is Bohemia deficient in animal productions; its cattle are of a good kind; its horses are peculiarly valuable; numerous flocks of sheep, and great herds of swine, are reared for a foreign market; and even the poultry of this country are deemed of a superior quality, and exported in great numbers to the surrounding provinces. Wild-fowl and game are also plentiful, and the Bohemian pheasant is reckoned the most beautiful in the world.

Social state.—Bohemia is said to contain 3,000,000 of inhabitants, who are generally distinguished for beauty of person and vigour of mind. They are described as having high breasts and sparkling eyes, undaunted courage and resolute perseverance. They are well known as excellent soldiers—patient of fatigue, and brave in action. Till very lately villenage prevailed in all its rigour; every man was either a despot or a vassal. In some instances the demands of feudal obligation have relaxed, and it is to be hoped that their remission will pervade the country till they be entirely dissolved. In 1714, this country was divided into twelve circles, through which are distributed 250 cities, 308 borough-towns, 11,455 villages, and 430,000 houses. Prague, the capital, stands on both banks of the river Moldau, fifteen miles in circumference, built on seven hills, and divided into four towns,—the old, the new, the little, and the Radshin towns. A bridge of 18 arches, and 1700 feet in length, connects the new and the old towns together. The churches and palaces of Prague are numerous; it is adorned also with a cathedral rich in relics, by a university founded by Charles IV. and, it is said, contains about 75,000 inhabitants.

Manufactures.—Almost every artificial production which cultivated society requires, is prepared in perfection and abundance. Bohemia manufactures woollen, linen, and silk; leather, stockings, hats, and gloves; pottery, stoneware, and glass; goods in iron, tin, brass, and other metals, both for ornament and use; in her founderies are cast artillery and bells for the whole empire; she excels in the manufacture of paper, mirrors, and flint-glass. For none of the commodities now enumerated has Bohemia occasion to resort to a foreign market; and, after serving herself, she has a considerable surplus for exportation. Many of her manufactured goods find their way into Austria, Turkey, Spain, and Portugal; her cut glass is in demand throughout Europe, and much of it goes to America. The roads are kept in good repair; and in 1749 Maria Teresa, with the view of encouraging commerce, established a regular mail between Vienna and Prague. It is obvious, from these statements, that the balance of trade must be in favour of Bohemia.

Government, &c.—This country is one of the hereditary possessions of the house of Austria, and its affairs are administered by six courts, or councils,—that of the regency, the chancery, the chamber of justice, the chamber of finance, the chamber of fiefs, and the tribunal for deciding the appeals of vassals. Taxes are levied from the land, the mines, &c. and contribute to the state between 15 and 17 millions of florins. The religion of Rome is established; but Jews and Protestants are protected in the rights of conscience by a liberal toleration.

History, &c.—In the remoter periods of her history, Bohemia, with the rest of Europe, was the seat of ignorance and the scene of barbarism; but the detail of the transactions of those times could afford neither instruction nor amusement. In 1275, when Ottocar, who had aspired to the imperial power, fell in the battle of *Weidendorf*, Rodolph I. of Austria, newly rid of his rival, and exhausted with the war, gladly concluded a peace with his widow, and recognised the title of Wenceslaus, her infant son, to his father's crown. His reign was turbulent, and on his death, as well as of that of several of his successors, a multitude of pretenders preferred their claims to the vacant throne, and not unfrequently enforced them by the sword; so that in a long series of years the sovereignty of Bohemia was neither obtained nor held as a peaceable possession. But when Charles IV. had ascended the throne, this hitherto distracted country enjoyed a long period of peace and tranquillity, in which she made rapid advances in science and civilization. Under this mild, but public spirited prince, the laws were reduced into a code which still bears the name of the *Caroline Constitutions*; he excited the industry of his people by enlarging and adorning the capital of his kingdom; and by the encouragement which he gave to commerce, and for the improvement of science and literature, he founded the university of Prague, to which students flocked from all quarters to receive their education among a people now distinguished throughout Europe for learning

Bohemia. and politeness. But, on his demise, through the weakness and wickedness of his sons, who were indolent, quarrelsome, and dissolute, Bohemia became again a scene of usurpation and misrule, which were increased and continued by the Hussite wars that arose and raged with a destructive influence. John Huss, a member of the university, had adopted the opinions of Wickliff of England, and began to inveigh with vehemence against the corruptions of the church. This conduct provoked discussions, in which the citizens sided with the reformer, and the students took part with the pope. A schism was the consequence, and all the foreign professors and students took leave of the university. Huss, and his disciple Jerome, propagated their opinions with equal zeal and success, and sustained persecution with unshaken fortitude, till they were decoyed to Constance, where, after a mock trial, they were committed to the flames.

This tragical event served only to cement the union, and to increase the energy of their party. John Ziska, the king's chamberlain, and an excellent soldier, had been roused to enthusiasm by the new doctrines, and, deeply affected by the fate of their authors, thought of nothing but revenge; and having interpreted some expressions of his master into a sanction of his designs, he left the court, put himself at the head of a small band, which rapidly increased to a mighty army, and proceeded to perpetrate the most wanton and bloody outrages. In 1419, he and his frantic followers slew the magistrates of Prague, broke into the churches, overthrew the altars, and destroyed the ornaments. During these proceedings Wenceslaus, the king, died; his queen, Sophia, assumed the regency, but the castle of Wishbrad, to which she had retired, was invested by so close a siege, that she was glad to purchase a suspension of hostilities by granting an unlimited liberty of conscience. Ziska then retired to the top of a mountain, which, in allusion to that of Palestine, was named mount Tabor, and which he fortified with such skill, that it became a sure asylum to all who fled from persecution. Here he bade defiance to Sigismund, the brother of the late king, though assisted by all the powers of Germany, and encouraged by the exhortations and fulminations of the pope; and the royal troops experienced such great and continued defeats, that the very name of the Hussites became a terror throughout the empire. But internal dissensions soon made them less formidable; two parties arose; and as each happened to be under the influence of reason, or the sway of passion, the partizan became a Calixtin or a Taborite. Sigismund had the address to foment and encourage the opposition of one party to the other; and, after a long negociation, he succeeded, in 1433, in effecting an accommodation with the Calixtins, soon after which the refractory Taborites were subdued.

Charles IV. who was both emperor of Germany and king of Bohemia, had established her rights in the Golden Bull, with freedom from public burdens; but she seldom availed herself of these privileges; and for a long period all connection between her and the empire was nearly suspended, till the crowns were again united in Ferdinand I. He and his successors made several ineffectual attempts to renew the former intercourse; and the only privilege enjoyed by the kings of Bohemia is the right of voting in the election of the king of the Romans.

BOHUS, or BAHUS, a province of Sweden, which has Norway for its boundary on the north, and West Gothland on the east and south, extends about 100 miles from north to south, is copiously watered by numerous lakes and rivers, which are abundantly stored with excellent fish, and timber, pitch, tallow, hides, lime, and fish are enumerated as the principal commodities of exportation.

Boileau. BOILEAU, SIEUR NICHOLAS DESPREAUX, one of the most distinguished French poets of the classical age of literature in the time of Louis XIV. was born in 1636. Descended from a family of lawyers, he was destined for the same profession; and having completed his academical course at the college of Beauvais, his studies were directed to the preliminary knowledge for his future occupation; but it soon appeared that these studies were little congenial to his taste,—and although he persevered till he was qualified for the practice of his intended profession, he at last relinquished it in disgust, and exchanged it for that of theology, which, in its turn, was soon abandoned as equally repulsive. Thus unfettered by any professional avocation, he resolved to indulge his passion for literary pursuits, and he returned with fresh ardour to poetry, from which, during his academical course, he had acquired considerable reputation. The Satires of Boileau, which appeared in 1666, exhibited to the public the most decided proofs of the powers and vigour of his genius, his sound judgment, and correct taste. The *Lutrin*, a mock heroic poem, which was published 1674, and in 1683, in six cantos, affords an excellent specimen of his talent for humorous description. This poem, the subject of which is a dispute between the treasurer and chanter of the holy chapel at Paris concerning the position of a reading desk, has been compared to the celebrated Rape of the Lock of Pope, from the similarity of character and humour which prevail in both productions, although it has been generally admitted that the superiority in fancy and execution belongs to the English poet, and in this judgment Voltaire himself has not hesitated to acquiesce. The critical skill of Boileau appeared in the *Art of Poetry*, and a translation of *Longinus*, which latter he enriched with many valuable notes.

The poetical productions of Boileau obtained for him not only the favour of Louis, but the more substantial reward of a pension, and the appointment, in conjunction with his friend, the celebrated Racine, of historian of the reign of that pompous monarch,—an appointment, it may be observed, which produced nothing, for the task which the associated poets had undertaken was never executed. The admission of the poet into the learned academies of France, which in most cases may be regarded as a matter of course, or of interest, need scarcely be noticed; and the detail of the controversy concerning the comparative merits of the ancient and modern authors, in which Boileau took a decided part, and much literary violence and personal animosity prevailed, could afford neither instruction nor amusement. He died in 1711, when he had reached the 75th year of his age.

BOILING, or Ebullition, is the agitation of a liquid when it is converted into vapour by the application of heat. As the heat is generally applied to the bottom of the vessel, the lowest stratum of liquid is first converted into the state of vapour, or steam, and this steam rising through the liquid produces the bubbling, or agitation, which is more or less violent in proportion to the heat applied. See Chemistry.

BOIS-LE-DUC, the capital of Dutch Brabant, stands at the confluence of the rivers Dommel and Aa, in a plain, which is nearly surrounded with morasses, is a place of considerable antiquity, strongly fortified, and defended by a castle. The approaches to the town, on the land side, are by causeways, and, by water at three separate gates. The cathedral, built in 1366, and reckoned one of the most magnificent structures in the Low Countries, was remarkable for a lofty wooden tower, supported by four stone pillars; but it was destroyed by lightning about the end of the 16th century. While in the hands of the catholics, the churches and other religious houses, some of which have been converted into warehouses, were numerous; and as the place is intersected by many canals, the accommodation of a great number of stone and wooden bridges is necessary. The population of Bois-le-Duc is about 10,000, and the chief manufactures are confined to linen cloth and different kinds of hardware.

BOKHARIA, an extensive region of Tartary. See Bucharia.

BOLCA-MONTE, a hill near a village of the same name in the Veronese territory in Italy, and about 20 miles distant from the city of Verona. Monte-Bolca has been long the subject of investigation and speculation among naturalists, on account of the extraordinary abundance of vegetable and animal petrifactions which it contains, and which clearly prove, although it is now not less than 50 miles distant from the sea, that it must have been at some remote period immersed in its waters. The rocks of which this hill is composed are of a marly or calcareous nature, and of a slaty structure. The summit consists of columnar basalt; but the most singular feature in the natural history of Monte-Bolca, is the prodigious accumulation of almost every kind of land and sea animals in a petrified state, as the remains of larger quadrupeds, birds, fishes, insects, and zoophytes; and it is not the least remarkable circumstance, that these organic remains have belonged to animals the species of which, in the present condition of the world, inhabit very different regions of the globe. Of the petrified fishes nearly one hundred different species have been discovered, most of which are now natives of the seas or rivers of Europe, but some of them are only found in the rivers of India and America.

BOLE, an absorbent earth, of which numerous varieties have been described by the older naturalists. See Mineralogy.

BOLETUS, a genus of plants belonging to the order of Fungi, under the Cryptogamia class.

BOLOGNA, or Bononia, a city of Italy, and capital of the duchy of the same name, stands in a beautiful plain at the foot of the Apennines, and on the banks of the rivers Savena and Rheno, is of an oblong form, five or six miles in circumference, and encompassed with high brick walls. The houses, which are flat-roofed, are in general built on arcades, the pillars of which are of wood or stone. The pavement for carriages is considerably lower than the porticos for foot-passengers; and as the streets are narrow, they present a gloomy aspect.

In the public buildings of Bologna, art seems to have exhausted all her resources, whether the grandeur of the designs, the magnificence of the structures, the splendour and variety of the decorations, or the unrivalled specimens of the productions of the pencil or of the chisel by the most celebrated masters, with which they are adorned, be considered. The public palace is one of the noblest buildings of the city. In this spacious edifice the municipal government and the courts of justice are accommodated; some of its apartments are appropriated to the museum of the celebrated naturalist Aldrovandi, and to a valuable collection of medals; and an extensive arsenal for military stores is included within its walls. The private palaces are also numerous and splendid; and the churches, the number of which is said to be not less than 200, exhibit a remarkable display of architectural beauty and elegance; and, when it is added, that few of them are unadorned with the most exquisite productions of the graphic art, furnished by the Caraccis, Albani, Guido Rheni, Raphael, Guercino, and others, the traveller who admires their genius and their works will not fail, when opportunity offers, to indulge his taste in contemplating these noble efforts of human skill.

The tower of Asinelli, which derives its name from the person by whom it was constructed in the beginning of the 12th century, stands in the centre of Bologna, and is not less remarkable for its great height, rising 370 feet from the ground, than for its inclination, which is more than three feet from a perpendicular position. But this inclination is exceeded by another tower, which has the appropriate appellation of the *leaning tower of Garisenda*, is 144 feet high, and deviates from the perpendicular more than eight feet. The elevation was originally much greater, but the instability of the foundation occasioned the fall of part of it, or required it to be taken down for safety.

The university of Bologna, founded in the early part of the fifth century, became a celebrated school of law, and attracted an immense concourse of students from all quarters. The college in which the sciences are taught still retains considerable celebrity; and the institutions for the improvement of the fine arts are numerous and excellent.

The population of Bologna is estimated at 70,000. The manufacture of velvets and other kinds of silk stuffs has been continued for nearly five centuries. To these are added the manufactures of crapes, gauzes, damasks, paper, and playing cards. For throwing silk and preparing it for the various fabrics for which it is destined, as well as for numerous other purposes, extensive machinery, driven by water, has been erected on the banks of the Rheno in the vicinity of the city. The trade with other towns of Italy, which is greatly facilitated by means of water-carriage, and with Venice, Germany, and France, in the various natural and artificial productions, such as hemp and flax, hams, dried tongues, sausages, maccaroni, olives, perfumes, and essences, beside the produce of the silk manufacture, is very considerable. The fertility of the soil, and the perfection of the cultivation, give to the surrounding territory all the richness, variety, and beauty of an extensive garden. The soil and climate are peculiarly favourable to the culture of the olive and the melon, and are equally congenial to the growth of tobacco; hemp shoots up with remarkable luxuriance; and the warmth and shelter afforded by the rows of mulberry trees and elms which surround the vineyards, elaborate and improve the juice of the grape.

Bologna seems not to have been a place of much importance in the flourishing periods of the Roman republic; it rose to eminence on account of its learned institutions about the 13th century; possessed some degree of independence under the German emperors; and when, by civil dissensions, it fell under the papal dominion, it still retained some of its ancient privileges and former distinction. In its civil polity Bologna presented the semblance of a republican form of government; the French became its masters in 1796, and, with other territories of Italy, it formed part of the Cisalpine republic; but since that immense fabric of usurped dominion has fallen, it has been no doubt restored to its original constitution.

BOLOGNIAN STONE, or SPAR, is a native sulphate of barytes, or heavy spar, which was first found in the neighbourhood of Bologna, from which the name is derived. After being exposed to strong heat, for the purpose of extracting the precious metal which it was supposed to contain, it emitted a phosphorescent light. See MINERALOGY.

BOLSENA, a town of Italy, which stands on a lake of the same name, encompassed with mountains covered with wood, is a place of no great importance, although it is surrounded with walls, and flanked with towers. The ancient Volsinium, one of the finest cities of Etruria, the temples and squares of which were adorned with 2000 statues, stood in the vicinity of Bolsena, and the ruins still furnish to the antiquary beautiful specimens of Roman art, in curious marbles and sculptured ornaments. The lake is 30 miles in circumference,—is the great resort of numerous water fowl,—is abundantly stored with various kinds of fish, and is remarkable for the extraordinary size of its eels. Two islands in the lake are occupied with religious houses, one of which contains a convent, to which extensive gardens are attached; and the other, a small spot, includes only a hermitage with its chapel. According to fabulous antiquity, these islands floated about in the lake, and this incredible story is alluded to by Pliny.

BOLSOVER, a town of Derbyshire in England, is situated on the declivity of a steep hill, is a place of great antiquity, and seems to have been protected by a strong castle, on the site of which a modern structure is raised. The manufactures of various kinds of hardware, once considerable, have been transferred to Birmingham; but it still retains its celebrity for tobacco pipes, which are reckoned the best in the kingdom. The population is estimated at 1000.

BOLTON LE MOOR, or BOLTON IN THE MOOR, a town of Lancashire in England, is divided by a rivulet into two parts, denominated Great and Little Bolton, and has been famous from the earliest times for its manufactories. The population, in 1773, was little more than 5000; in 1801 exceeded 17,000; and in 1811 had increased to 24,000. The annual returns from the manufacture of fustians, calicoes, dimities, counterpanes, muslins, and all other kinds of cotton goods, are estimated at more than one million Sterling. The Wigan cannel coal, in the vicinity, furnishes employment to some of the inhabitants of Bolton, in making various utensils and trinkets of that substance, which takes a fine polish, and is converted into snuff-boxes, candlesticks, &c. The inland navigation affords numerous facilities to the manufactures and trade of this place.

BOMBAX, the SILK COTTON TREE, a genus of plants belonging to the Monadelphia class.

BOMBAY, an island on the western coast of India, about ten miles in length, and three in breadth, situated within the 19th degree of north latitude, and the 73d of longitude east from Greenwich, and is one of the three English presidencies in that part of the world.

Productions.—This island, being full of inhabitants, is in a high state of cultivation, although not remarkable for its fertility; but it is celebrated over the east for the excellence of its onions; the common and sweet potatoe are also raised in it of a good quality; rice is cultivated, as in the rest of India; cocoa nuts are abundant, and other fruit trees indigenous to the climate; buffaloes, sheep, goats, and poultry are plentiful; game, such as red-legged partridges and snipes, is not scarce; the shores are also frequented by fishes of various kinds and of excellent quality; of these the prawn is uncommonly fine, as also the *bumbelo*, resembling a large sand-eel, which is dried and eaten to breakfast; the frogs grow to a large size, and are sometimes eaten both by the Portuguese and the Chinese.

Inhabitants.—The human beings residing in Bombay are estimated at 220,000. Of these, three-fourths are Hindoos, 8000 are Mahometans, 8000 are Parsees, 4000 are Jews; the rest are Portuguese, English, &c. The Parsees, who are Persian emigrants, and disciples of Zoroaster, dwell chiefly in those districts which are under the jurisdiction of the president of Bombay. They still adhere to their ancient customs; they wear an Asiatic dress; they adore the sun, the sea, and fire. They have a singular mode of interring their dead. For this purpose, a piece of ground is surrounded with a triple wall, having a well sunk in the centre. In the space nearest the well they deposite their children taken from them by death; the outer division is alloted to the males, and the intermediate one to the females. Here the bodies are exposed till their flesh is devoured by vultures, when the friends with pious care collect the bones and throw them into the well. The Parsees are an active and an industrious race; the soil is chiefly in their possession, which they cultivate with care; they make excellent ship-builders, and patient labourers. Almost every mercantile house has a Parsee partner, who generally advances the principal part of the capital; and in every respect this tribe contributes greatly to the prosperity of the settlement. The liver complaint is the most prevailing disease of Bombay, and exposure to the night breeze is apt to induce fever. In other respects it is not unhealthy.

City.—The town of Bombay was originally built and fortified by the Portuguese; but it has been greatly enlarged and strengthened since their time. It is now about a mile in length, strongly defended on all sides, especially towards the sea, where it is deemed impregnable. The fort is washed on three sides by the waves, and presents a very imposing appearance. The English have a church within the fort; a presbyterian church has been lately erected; and the Portuguese, the Armenians, and Jews, have places of worship both in the town and the suburbs. The houses consist chiefly of a single story, and, contrary to the Indian mode of architecture, have sloping roofs covered with tiles. The English have country houses, which generally command delightful prospects.

Commerce.—Bombay has attained to greatness, and derives the whole of its present importance from its facilities for commerce. Its capacious harbour, capable of containing more than 1000 ships of burden, is sheltered on all sides from the violence of the waves. Its situation commands an easy access to the richest and the rarest productions of the most favoured regions of the earth. Hence, it has become the centre of the entire trade of the north-west coast of India. Cotton is the principal commodity, which is collected from all the neighbouring districts and exported to China. But this place is also the depot of sandal-wood, pepper, &c. from the Malabar coast; of gums, drugs, coffee, and pearls from Persia, Arabia, and Abyssinia; of ivory, precious stones, piece goods, and other manufactured commodities, from Cambay, &c.; of sharks' fins, birds' nests, &c. &c. from the Maldive and Lacadive islands; and of manufactured goods, porter, grain, &c. from England. From this great mart, thus composed of such various productions, and collected from so many places, many ship loads are annually exported to numerous and far distant countries. The most of the cotton, a great deal of manufactured goods, wine, &c. are carried to China. The produce of Gujrat, of Persia and Arabia, and the manufactures of Cashmere, Surat, &c. are annually transported to England. The goods of this market are also in demand in Goa and the Brazils, as well as in all the countries and districts in the north and west of India, so that both the import and export trade is prosperous. The most of this trade is carried on in English bottoms. The ships which are built here of teak timber are said to be greatly more durable than other Indian-built vessels. The teak is brought from the mountains of Gujrat, or from Rangoon, a Birman sea-port.

Establishment.—The president of Bombay's jurisdiction extends over the districts of Surat, Broach, Cambay, Gochwarah, and other countries in the province of Gujrat, by far the most fertile, populous, and best cultivated region in India, abounding in large towns and excellent harbours. A single judge, with the title of recorder, holds a court of judicature, to which three barristers and eight attornies are attached. The whole establishment of Bombay consists of about 75 civil servants, 550 military officers, and 21,000 soldiers, 40 surgeons, and five chaplains, the annual expence of which amounts to L.373,359. The Company's marine, to protect the trade, consists of 15 ships of war, armed boats, advice boats, and others, which give employment to a considerable number of officers and men.

History.—The Portuguese obtained possession of the island of Bombay in the year 1530, and, delighted with the fineness of its harbour, they built on its shore a town and a fortress. But it was too near their capital Goa to rise, under them, to any high degree of importance. When Charles II. married Catherine, the princess of Portugal, this island was ceded to him as part of her portion. The king, however, having learned that the traffic which his servants carried on in this newly acquired possession, injured the regular commerce of the English East India Company, transferred it, by letters patent from the crown, to that body, on condition of their paying the annual rent of L.10 in gold; and, in consequence of this transaction, Sir George Oxinden, the Company's governor, received possession of the island of Bombay, with the garrison, the arms, ordnance, and stores.

The revenue of this establishment was, in 1668, nearly L.7000. About this time a mint was established, where rupees and other Indian money were coined. But it still continued unhealthy, and exposed to the depredation of the Mahratta pirates; and though the garrison consisted of 400 regulars and 300 militia, and 100 cannon were mounted on the fortifications, the vigorous government of Aurengzebe and the other native powers on the coast, kept it in a state of perpetual alarm.

After the capture of Bantam by the Dutch in 1684, the court of directors constituted this station an independent settlement, and the seat of the trade and power of the English nation in the East Indies. Two years afterwards the English government of Surat was also transferred to this island, and about the same time it was infested by enemies and afflicted by the plague. In 1700, Sir Nicolas Waite, the English Company's resident at Surat, procured, by means of his intrigues, the imprisonment of Sir John Gayer and Mr Colt, the Old London Company's servants. On the union of these two rival bodies in 1708, Sir Nicholas was dismissed, but Gayer and his associate were not released from their confinement. At this period the settlement was so much distracted by faction, so closely invested by enemies, and so dreadfully reduced by the plague, that, to conceal its weakness, its governors declined to receive an envoy from the king of Persia.

Such was the original condition of this important settlement, which thus by slow degrees, and amid disastrous circumstances, has become one of the greatest commercial stations of the east. In 1802 it obtained an accession of territory from Anund Guicowar, a Mahratta prince; the island of Bombay has also been lately united to that of Salsette by means of a causeway; and at present the jurisdiction of this presidency extends over a considerable part of the adjoining coast, and even exerts a sensible influence in Persia and Arabia. The travelling distance from Bombay to Calcutta is 1300 miles.

BOMMEL-WAERT, the *Insula Batavorum* of Cæsar, is an island of Holland, which is formed by the rivers Meuse and Waal; is about fifteen miles in length, and six miles in breadth, contains Bommel and some other towns, with several forts for its defence, and possesses in many places a rich and fertile soil, which produces abundance of corn and fruits.

BOMMEL, the chief town of Bommel-Waert in Holland, stands in a fine plain, which is remarkable for its fertility and vegetable productions, includes about 3000 inhabitants, and at one time enjoyed an extensive trade, which, on account of the difficult access to the harbour, occasioned by sand banks, has been transferred to Bois-le-Duc.

BONA, or BONNE, a sea-port town of Algiers, in Africa, formerly the capital of the province of the same name, supposed by some to be the ancient Hippo, and was once distinguished for trade, wealth, and population. The surrounding territory produces abundance of corn, fruits, and cattle; and the exportation of grain, oil, hides, wax, and wool, by the European mercantile establishments, was the principal source of the commercial prosperity of Bona. A valuable coral fishery on the banks in the bay is successfully prosecuted by the Genoese and the natives of other states of Europe; and it is said, if properly regulated and encouraged, might afford profitable occupation to 10,000 men.

By a contract entered into with the dey of Algiers in 1806, Bona and some neighbouring places were to be put in possession of the British, for the purpose of forming commercial settlements, and the stipulated sum of 11,000 Sterling was paid for the privilege; but it is not understood that any establishment was made.

Bona was the scene of a most barbarous outrage on the Christians engaged in the coral fishery in 1816. To check the predatory practices of the Algerines and other Barbary states, and particularly to force them to abolish the disgraceful slavery to which they doom their unfortunate Christian captives, under the too lenient connivance of the European powers, a British squadron, under Lord Exmouth, appeared before Algiers, and obtained a compliance with the reasonable conditions required; that peace should be made with Sicily and Sardinia, that their captives should be restored at a moderate ransom, and that all future prisoners of war should be treated according to the usages of civilized nations. But the British admiral, after concluding the treaty, had no sooner left the coast, than it was violated by the perpetration of a dreadful massacre of the crews of some hundred Neapolitan boats engaged in the coral fishery on the coast. This cruel massacre was the consequence of a premeditated design. A gun fired from the castle was the signal of attack on the defenceless fishermen; two thousand Moors and Turks rushed upon them, and, supported by the guns from the forts, involved the whole in indiscriminate carnage, so that not one escaped. The British flag, under the sanction of which the fishing operations were carried on, was torn down and treated with the utmost indignity. This inhuman outrage brought on these rapacious barbarians the signal chastisement which was inflicted by the same admiral on the memorable 27th of August of the same year, and thus led to the unconditional acquiescence of the dey of Algiers in the terms proposed by the British government.

BONAIR, or BUEN-AYRE, an island which lies on the north coast of South America, 30 miles east from Curaçoa, about 50 miles in circumference, with a good harbour on the south-west side, and produces maize, yams, and potatoes, some part of which is exported to Curaçoa. Cotton is also among the vegetable productions of Bonair, and some cattle and goats are reared.

BONAVISTA, or BUENA-VISTA, so denominated from the delightful aspect which it presented to the first discoverers in 1450, is one of the Cape de Verd islands, about 50 miles in circumference, has two bays which admit ships, and which are distinguished by the names of English and Portuguese bays, but are both somewhat inconvenient on account of shoals and banks, and is said to contain about 8000 inhabitants. The maritime parts of the island are low, but the central regions rise into hills; the soil is light and sandy, and not well cultivated; and salt, cotton, and indigo are the chief productions. Milk, goats flesh, fish, and turtle, furnish the principal food to the inhabitants; and their superabundant produce is exchanged with English vessels for old clothes, meal, and biscuit. Cotton and indigo would thrive well in the soil and climate; but the natives are indolent, and careless in the culture of the former, and follow a very rude process in the manufacture of the latter.

BOND, a deed or written obligation, by which a person binds himself, his heirs, executors, and administrators, to perform some act, or to pay a certain sum of money to another at a fixed time. In this form a bond is called a simple obligation. But there is generally a condition added, that if the person bound does some particular act, the obligation shall be void, or shall remain in full force; and in case this condition is not performed, the bond becomes forfeited, or absolute at law, and charges the person bound while living, and after his death the obligation descends upon his heir, who is bound to discharge it.

If any condition of a bond be impossible at the time of making it, or if it be contrary to some rule of law, that is, merely positive, or if it be uncertain, the condition alone is void, and the bond shall stand single and unconditional. If the condition be an obligation to perform something that is immoral in itself, that obligation is void; and if the condition be possible at the time of making it, but if it become impossible by the act of God, the act of the law, or the act of the obligee himself, the penalty is saved, because no prudence or foresight of the person bound could guard against such contingency.

When no time is fixed for the payment of a bond, it is then held to be payable on demand; but, even in this case, a reasonable time is allowed by the courts of law for the payment. On the forfeiture of a bond the whole penalty was formerly recoverable by law, but courts of equity do not permit more than the principal, interest, expenses, and reasonable damages sustained by non-performance of the conditions; and by special statute it is ordained, that in case a bond for the payment of money be forfeited, and a suit commenced, the tender or payment of the principal sum, interest, and costs, shall be a full satisfaction and discharge. Blackstone's *Commentaries*.

By the law of Scotland a bond is either *heritable* or *moveable*. All bonds which bear a clause of infeftment, beside the personal obligation to repay the principal sum and interest, are heritable. Bonds merely personal have been always considered moveable before the term of payment, but afterwards they are held to be heritable. But by statute 1661, all sums in contracts and obligations are made moveable in regard to succession; but in reference to the fisc, and the rights of husband and wife, they continue heritable, with the exception of bonds bearing an obligation to infeft, and such as are payable to heirs and assignees, secluding executors, which are in all respects heritable.

A bond which is payable to heirs, without any mention of executors, descends not to the heir in heritage, but to the executor; but a bond which is taken payable to heirs-male, or to a series of heirs, is heritable; and bonds which are originally moveable, may become heritable, either by destination, or in consequence of a supervening heritable security. All bonds, whether they are personal or heritable, before seisin, may be affected by creditors, either by adjudication or arrestment.

BONDOU, a district or kingdom of Africa, which is included between the rivers Gambia and Senegal, and has for its boundaries on the east and south-west Bambouk and Wooll; is an elevated region, many parts of which are covered with woods; the Faleme is the principal river; and a large proportion of the district is said to be fertile in grain. Fatteconda is the principal town; and the inhabitants in general, who are said to be remarkable for their industry, are chiefly occupied in agriculture and the rearing of cattle. The Mahometan faith has been established, and the natives are represented as being very exemplary in the observation of its laws and the practice of its precepts. The Arabic language is spoken by the inhabitants of Bondou, and this may be regarded as a natural consequence of the introduction of the Mussulman religion. A French traveller, who visited this country in 1786, describes the village of Coursan as the residence of the king. This place is fortified with palisades, and is supposed to contain more than a thousand inhabitants.

The inhabitants of Bondou belong chiefly to the Foulahs, who are of a yellow complexion, with small features and soft silky hair, naturally, it is said, of a mild disposition, and gentle and tractable in their manners. The trade in slaves was at one time considerable, and the barter of corn for iron, gold-dust, and different kinds of gums, is still carried on. A coarse cotton cloth is manufactured and dyed with the cotton and indigo produced in the country. Ivory is also a valuable commercial commodity in Bondou. But after all that has been said by travellers of the abundance and profusion which the inhabitants of this region enjoy, of the wisdom of their government and laws, and particularly of their moderation in giving no encouragement to religious persecution, it cannot be doubted, from the relations of the same travellers, that they are not less barbarous than the other natives of that uncivilized country, and not less rapacious and oppressive in their exactions from strangers. The first question put to the French traveller already alluded to, when he was admitted to the presence of the king of Bondou, was a demand for presents; and no small disappointment was expressed when none was produced, and a threat was offered that he would not be suffered to depart.

BONES, the solid parts of animal bodies; for an account of the structure and uses of which, see ANATOMY.

BONN, an ancient city of Germany, and the usual residence of the electors of Cologne, occupies a fine situation on the left bank of the Rhine. The streets are generally narrow; the cathedral, the town-house, a Gothic structure adorned with paintings, and the palace of the elector, a magnificent edifice erected in 1777, are the principal buildings. The great rampart affords a very extensive and delightful view of the course of the Rhine and the adjoining country. The population is estimated at 9000. The mineral springs at the distance of three miles from Bonn have acquired considerable celebrity, and, before the revolution, were much resorted to; but the military occupation of the place by Bonaparte was fatal to the fine walks, pleasure gardens, and elegant buildings, which were laid out and constructed by the electors for the accommodation of visitors.

BONNER, EDMUND, an English bishop, whose vindictive spirit, religious zeal, and versatility of opinions have given his name a conspicuous place in the history of the times in which he lived, was a native of Worcestershire, and, according to one account, was the natural son of a priest, but, according to another, was descended of parents in humble life, the place of whose residence, it is said, still retains the name of *Bonner's Place*. Admitted as a student at Oxford in 1512, after seven years residence he took his degrees in canon and civil law, was soon after ordained and appointed to a living in the church. With the reputation of an able politician, he was fortunate in obtaining the favour and patronage of the celebrated cardinal Wolsey, who raised him to offices of high trust, and loaded him with ecclesiastical preferments. Besides being archdeacon of Leicester, and a prebend of St Paul's, he held livings at the same time in Yorkshire, Worcestershire, and Norfolk. The disgrace and death of his patron, the ambitious cardinal, did not interrupt the fortunate career of Bonner, for he was successful in obtaining the favour of Henry VIII., was appointed one of his chaplains, and proved a useful instrument in the hands of that tyrannical monarch, in promoting his divorce from queen Catharine, and in abrogating the supremacy of the pope in England.

In the violent struggle which Henry maintained with the papal court, Bonner was twice sent to Rome to appear on behalf of his sovereign; and on one occasion his firmness of conduct, or rudeness of manner, drew from the pope a violent threat of summary vengeance on his person. Dreading the consequence, he deemed it most prudent to withdraw;

and having returned to England he was promoted, at the recommendation of the reformers, first to the see of Hereford, and soon after to that of London.

During the reign of Henry, Bonner was an active and zealous opponent of popery; but when he had obtained high preferment in the church, or had changed his views, he refused to take the oaths of abjuration and allegiance on the accession of Edward VI. His commitment to prison produced a recantation and submission, which were followed by his enlargement. But his private conduct did not correspond with his public professions, for he was still disposed to support the cause and promote the re-establishment of popery; and, after a minute enquiry under the authority of a commissioner, and a long trial, during which, it is recorded, he behaved more like a madman than a bishop, he was again sent to prison and deprived of his bishoprick.

The accession of Mary in 1553 was a fortunate event to Bonner, in restoring him to his honours and emoluments, while it afforded an opportunity of a full display of his natural disposition and true character. Elevated to the high station of president of the convocation in place of archbishop Cranmer, who was degraded and sent to the Tower, he began the dreadful work of persecution, with a perseverance and cruelty which have been rarely equalled. Exclusive of those who were subjected to imprisonment, public whipping, and severe torture, it is said that not fewer than 200 persons perished in the flames, by his agency, within the short period of three years.

The accession of Elizabeth in 1558, produced a favourable change to the persecuted reformers. Bonner appeared among the protestant bishops who congratulated the queen on that event; but his doubtful character seems to have excited suspicion in that princess. He was coolly received, lived for some time unnoticed, and probably foreseeing the fate that awaited him he refused to take the oaths, was degraded and committed to prison, where he died, after ten years confinement, in 1569. To prevent the indignity and violence of the irritated populace, his body was privately interred.

The narrative of this prelate's life affords ample evidence that he was of a violent temper and cruel disposition, actuated by strong ambition, and little scrupulous of the means he employed in promoting his views; but the bloody persecution which he instigated, during the reign of Mary, must remain an indelible stain on his memory.

BONNET, Charles, a distinguished naturalist, was descended from a French family, who had fled from their native country on account of religious persecution, and who had taken refuge in Switzerland, and was born at Geneva in 1720. He was an only son, and his father bestowed a large share of attention on his education; but either his dislike to the dry study of grammar, or a deafness with which he was early afflicted, rendered his progress in education at the public school less rapid than his friends expected; he was afterwards intrusted to the care of a domestic tutor, and, under him, his advances in general learning were promising and successful. At the early age of sixteen, his taste and bias for the study of natural history seemed to have been completely formed; and the perusal of Reaumur's Memoirs on Insects led him to repeat and extend the curious observations and experiments of that illustrious naturalist,—the details of which being communicated to him, excited no small degree of admiration of the sagacity and acuteness of the young philosopher.

Destined by his father for the profession of the law, Bonnet entered reluctantly on the requisite studies; but this was merely a formal acquiescence, and regarded as an unwelcome task, for his inclination led to very different pursuits, and his mind was occupied with other objects. Beside other investigations in natural history in which he was engaged about this time, he communicated, in 1740, to the academy of Sciences, the result of a curious inquiry respecting the multiplication of *aphides*, or tree-lice; and in the succeeding year he instituted an interesting series of experiments on the effects that follow the division of worms, from which it appeared that many species possessed, in some degree, the same remarkable reproductive powers as the polype. The minute observations in which he had been long engaged, and particularly the constant use of the microscope, which was necessary in the prosecution of some of his inquiries, greatly affected his eyes, as well as his constitution, and obliged him for a time to decline every kind of study. The temporary relaxation which he enjoyed materially improved his health, and again enabled him to resume his inquiries concerning vegetation. The ascent of the sap, and the action of the upper and under leaves of plants were the next subjects which occupied his attention, and the result of his labours appeared in a separate publication.

From physiological studies Bonnet turned to metaphysical speculations, and soon became a voluminous writer on this fruitful subject of inquiry. His *Essay on Psychology*; *Analytical Essay on the Faculties of the Soul*, *Contemplations on Organised Bodies*, and *The Contemplation of Nature*, successively appeared, and met with approbation and applause. The last production of Bonnet is entitled *Palingenesie Philosophique*, and treats of the past and future state of living beings; and to this work is annexed an inquiry into the evidences of the Christian revelation and the doctrines of Christianity. Some other subjects of natural history again attracted his attention, and occupied part of his leisure in the remaining years of his life; and although he was attached by inclination and habit to studious retirement, he did not altogether relinquish the social duties of a citizen. For the period of sixteen years he was a member of the great council of the republic, and often distinguished himself by his manly eloquence in the support of wise and moderate measures, and in the cause of morals and religion. The last labours of the philosopher were devoted to the revisal and correction of his works, which were published in a general collection, in nine volumes quarto. They are all written in the French language, but many of them have been translated into English and other languages. He died in 1793, at the advanced age of 73; and such was the respect in which he was held by his countrymen, that public honours were paid to his remains.

BONNETIA, a genus of plants belonging to the

Polyandria class, and so denominated to commemorate the name of the great Swiss naturalist.

BONONIA, a city of Italy. See BOLOGNA.

BONONIAN STONE, a mineral substance, which has received this name from being found near Bononia in Italy, and which, after being subjected to heat, gives out light in the dark. This mineral is heavy spar, or sulphate of barytes. See CHEMISTRY.

BONONIAN JAR, OR BOTTLE, denominated also Philosophical Phial, is a thick glass-jar which has not been subjected to the process of annealing, and which exhibits the singular property of breaking into minute fragments, when a small bit of flint is dropped into it, although it is capable of bearing a considerable blow externally. See ANNEALING.

BONPLANDIA, a genus of plants belonging to the Pentandria class, and so named in honour of the enterprising traveller who accompanied Humboldt in his arduous journey through South America.

BONTIA, a genus of plants belonging to the Didynamia class.

BONZES are priests or monks in eastern countries, who are devoted to the religion of Fo, are very numerous in those regions where that superstition prevails, and are distinguished by different names. In the kingdom of Siam they are denominated *Talapoins;* in China they are called *Ho-chang;* in Tartary *Lamas;* in Japan the usual appellation is *Bonzes;* and by this latter name they are generally known in Europe. The institutions of the Bonzes have some resemblance to the monastic establishments of the church of Rome; they live in separate communities, and in retirement from the affairs of the world, bind themselves by vows of perpetual celibacy, and attach themselves to particular pagodas or temples. Female institutions of Bonzes are also known in some of the countries of the east. As the doctrine of the transmigration of souls is a tenet of general belief in Asiatic regions, temples are erected to different kinds of animals, which thus become the objects of public veneration and worship, from the notion that the soul of the god in his various transmigrations may have occupied their bodies. On this account the worship of the god Fo is conducted by these devotees under the form of different animals into which he is supposed to have passed in the various stages of his existence.

The Bonzes are very numerous in some parts of China, many of their establishments are richly endowed, and possess extensive domains; and as a great portion of their revenue depends on the superstitious veneration in which they are held by the people, they have had recourse to the various arts of mendicity to increase their income. To excite the commiseration of their countrymen more effectually, and to increase the liberality of those who are disposed to give them alms, they subject themselves to the severest mortifications, and sometimes to the most painful sufferings, appearing in the public places loaded with heavy chains, cutting and mangling their bodies till they stream with blood, carrying burning coals on their bare head, and examples are not wanting of some who inclose themselves in narrow boxes or cases stuck full of sharp nails, so that the flesh is torn by the slightest motion. But besides these open means of obtaining charity, the Bonzes are charged, and perhaps justly, with practising the most nefarious arts of imposture and fraud in exciting the beneficence of the public, and the dissolute lives of some are remarkable for selfishness, profligacy, and cruelty. With all the superstition of the Chinese, the Bonzes are held in great abhorrence by that people, and their detestable practices meet with frequent and severe checks from the public authorities. In the northern part of China these devotees are little encouraged, and the pagodas to which they were attached are now greatly neglected, and most of them have fallen into decay.

BOOBY, a sea bird belonging to the genus Pelican. See Pelicanus under ORNITHOLOGY.

BOOK, a general denomination for any literary composition, but, in a more restricted meaning, is applied to such works of this description as are of sufficient magnitude to form a volume. Smaller productions are distinguished by the name of pamphlets; and from the size or form of books appropriate appellations have arisen. When the whole sheet is employed, the book is said to be in *folio*; when the sheet is folded once, and thus forms four leaves, or eight pages, it is said to be in *quarto*; and when the sheet is folded twice, it makes eight leaves, or sixteen pages, and is then called a book in *octavo*; and so on, according to the number of leaves of which the sheet is composed.

Origin of books.—As books are to be regarded as written records of the thoughts and transactions of mankind, their origin may be traced, in some form or other, to the invention of letters or characters, which are the representative signs of language. The materials of which books have been composed have been extremely different in different nations, and in different periods of the progress of civilization. Letters, or hieroglyphical characters, were written or engraved on tables of stone, or wood, but more frequently on the bark of trees, a substance which could be readily procured and easily prepared for the purpose; and hence the Latin word *liber*, as well as the English word book, derived from a Saxon word, and the corresponding denomination, refer to the same origin, and denote the bark of some part of a tree of which books were originally made. The materials of books were afterwards derived from the *papyrus*, a plant which is a native of Egypt, and which obviously gave its name to *paper*. The use of papyrus, it is said, was common among the ancients in the time of Alexander the Great. As the demand for books increased, more durable materials were sought for, and leather, made of the skins of goats or sheep, was employed. The use of parchment prepared from skins next followed, and, it is said, was invented at Pergamus, when the exportation of the Egyptian papyrus was prohibited. The ancient manuscripts are chiefly written on this substance, for it was not till about the 12th century that the method of manufacturing paper was known.

Attempts have been made to discover and apply to use, in the fabrication of books, materials of a still less perishable nature than any of the substances already alluded to. It has been proposed to manufacture linen from asbestos, the mineral substance

Book.

from which the famous incombustible cloth of the ancients was made, and which would be proof against fire; and in the rage, as it may be called, for the extreme durability of books, this attempt has been carried still farther by proposing an everlasting book, the whole of which was to be made of asbestos, the leaves, the cover, and the thread with which the leaves are stitched together. The writing was to be composed of letters of gold; and thus the whole would be formed of very indestructible materials.

Many changes have taken place in different countries, and at different periods, in the internal order and arrangement of letters into lines and pages. At first the letters were only divided into lines; they were afterwards separated into words, and were gradually marked with accents, and distributed by points and stops into periods, paragraphs, and chapters. In some countries the lines proceeded from the right to the left, in others, as among the northern and western nations, they ran from the left to the right; the Greeks followed both directions, alternately going in the one and returning in the other; but in the Chinese mode of writing, the lines run from top to bottom.

Scarcity of books.—Before the manufacture of paper was known, and the invention of printing, the labour and expence of multiplying books rendered them extremely scarce. On this subject Mr Warton, in his history of English poetry, has collected many curious anecdotes. The number of books, he observes, in the papal library at Rome, about the end of the seventh century, was so inconsiderable, that the pope made a formal request to the bishop of Maestricht to supply the defect from the remote parts of Germany; and about the middle of the ninth century, the abbot of Ferrieres in France sent two of his monks on a mission to the pope to beg a copy of *Cicero de Oratore* and *Quinctilian's Institutes*, because, although he was in possession of part of these books, yet no entire copy of them existed in all France. The abbot of Gemblours, with great trouble, and at an immense expence, having collected 100 volumes on divinity, and 50 volumes on profane subjects, thought himself master of a splendid library. The emperor Charlemagne, about the end of the eighth century, granted an unlimited right to the abbot and monks of Sithin for making their gloves and girdles of the skins of the deer they killed, and covers for their books. On this privilege, it is facetiously remarked, that these religious were fonder of hunting than of reading; at any rate they were obliged to hunt before they could read; and it seems probable, in such circumstances, and with such materials, the manufacture of volumes was not very prosperous. In the beginning of the tenth century, books were so scarce in Spain, that the same copy of the Bible, of St Jerome's Epistles, and some volumes of ecclesiastical offices and martyrologies, often served several different monasteries.

The constitutions framed for the regulation of the monks in England, by archbishop Lanfranc, in the year 1072, afford another proof of the scarcity of books at that period. At the beginning of Lent the librarian was ordered to deliver a book to each of the religious; a whole year was allowed for its perusal, and at the returning Lent those monks who had neglected to read the books they had received, were commanded to prostrate themselves before the abbot and supplicate his indulgence. In a catalogue of the library of the bishop of Winchester, drawn up in 1294, the whole number amounts only to seventeen books on different subjects. The bequest of a Bible in two large folio volumes, with the original annotations, certainly a valuable donation in those times, procured for the liberal donor, bishop Nicholas of Ely, the institution of a daily mass for his soul by the monks of the convent of St Swithins at Winchester, on whom it was bestowed. When a single book was bequeathed to a friend or relation, it was usually accompanied with many stipulations and restrictions; and the gift of a book to a religious house was regarded as a donation which merited eternal salvation; it was offered on the altar with great ceremony, and the most formidable anathemas were denounced against those who should dare to alienate so precious a gift. Of the formalities observed in making the bequest of a book, the following is an example. "I Philip of Repyndon, late of Lincoln, give this book, called *Peter de Aureolis*, to the new library to be built within the church of Lincoln; reserving the use and possession of it to Richard Trysely, clerk, canon, and prebendary of Milton, in fee, and to the term of his life; and afterwards to be given up and restored to the said library, or to the keepers of the same for the time being, faithfully and without delay. Written with my own hand, A. D. 1422."

The royal library of Paris, about the beginning of the fourteenth century, contained only four classics, namely a single copy of Cicero, Ovid, Lucan, and Boethius; the rest consisted of books of devotion, treatises on astrology, chiromancy, and medicine, originally composed in Arabic, and translated into Latin and French, and pandects, chronicles, and romances.

As a proof of the scarcity of books in England about the middle of the fifteenth century, the following order, which is recorded in the statutes of St Mary's college at Oxford, founded in 1446, has been quoted: "Let no scholar occupy a book in the library above one hour or two hours at most, that others be not hindered from the use of the same."

Early manuscripts, it is obvious, must always be scarce, and when they are well executed are highly prized by bibliographers; but the scarcity of printed books is owing to various causes, as the suppression of particular works on account of their immoral, irreligious, or seditious tendency,—a small impression of some books,—accidents which have happened to printing-offices and warehouses, as in cases of their being destroyed by fire,—the unfinished state of some books, and the expensive materials on which others are printed. Books which have escaped such accidents are much sought after by collectors, and, as well as first editions from ancient manuscripts, early editions of celebrated printers, such as are distinguished by peculiar characters, and such as have not been exposed to sale, bring extraordinary prices.

High prices of books.—Of the excessive prices of books in the middle ages, some curious examples are recorded. Bede's Homilies, and St Austin's Psalter, were purchased in the year 1174, by Walter, prior of St Swithins, at Winchester, for twelve measures of barley, and an embroidered pall. The countess of Anjou paid 200 sheep, five quarters of wheat, and an equal quantity of rye and millet, for a copy of the Homilies of Haimon, bishop of Halberstadt; and, about the year 1400, a copy of John of Meun's *Roman de la Rose* was sold before the palace gate at Paris for forty crowns, or L.33, 6s. 8d. But of the prevalence of bibliomania in modern times, a better proof cannot be selected than the sale of the duke of Roxburgh's library in London in the year 1812. That nobleman had been long known as an assiduous collector of the rarest editions of books. The sale extended to forty-two days, and it is supposed that the whole collection brought nearly L.30,000. As it forms a curious feature in literary history, the reader may be gratified in seeing the prices and purchasers of some of these highly valued productions.

The Festival; printed by Caxton, in two columns. L.105, bought by Lord Spencer.

The Prouffytable Boke for Mane's Soul, called the Chastysing of Godde's Chyldren; printed by Caxton. L.140, Lord Spencer.

Lyf of Saint Katherin of Senis; printed by Caxton. L.95, Mr Clarke.

Sessions Papers and Trials at the Old Bailey, from 1690 to 1803. 2 vols. in folio, and 80 vols. in 4to. L.378, Mr Read.

A Translation of Cicero on Old Age; printed by Caxton. L.115, Mr Nornaville.

The Boke of Seynt Albons; printed at St Albans, 1486; imperfect. L.147, Mr Triphook.

The Mirrour of the World; printed by Caxton in 1480. L.351, 15s. Mr Nornaville.

The Kalindayr of the Shyppers, folio; printed at Paris, 1503. L.180, Mr Nornaville.

Callimachi Hymni. Florence, 1472, 4to. L.63, Mr Payne.

A Discourse of English Poetrie, by W. Webbe, 1586, 4to. L.64, Mr Triphook.

Paradise of Daintie Devises, 4to, 1580. L.55, 13s. Mr Rice.

A Collection of Old Ballads, in 3 vols. folio. L.477, 13s. Mr Harding.

Guy Earl of Warwick, a metrical romance; printed by Copeland, 4to. L.43, 1s. Mr Heber.

Love's Martyr, or Rosalin's Complaint, by Chester, 4to, 1601. L.24, 3s. Mr Dubois.

Gower's Confessio Amantis; printed by Caxton, 1493, folio. L.336, Mr Payne.

Chaucer's Canterbury Tales, a manuscript on vellum, folio. L.357.

Chaucer's Works, by Pynson, 1526, folio. L.30, 9s. Mr Evans.

The Passetyme of Pleasure, by Stephen Hawys; printed by Wynkyn de Worde, 1517. L.81, Mr Dibdin.

The Exemple of Vertu, by Stephen Hawys; printed by Wynkyn de Worde, 1530. L.60, Mr Rice.

History of King Boccus and Sydrake. L.30, Mr Triphook.

The Complaynt of a Lover's Life, 4to, printed by Wynkyn de Worde. L.58, Mr Nornaville.

The Castell of Pleasure, 4to, printed by Wynkyn de Worde. L.58, Mr Nornaville.

The Love and Complaynte between Mars and Venus. L.60, Mr Dibdin.

Watson's translation of Brant's Ship of Fools, 4to. L.64, Mr Nornaville.

Churchyarde's Works, 2 vols. 4to. L.96, Mr Triphook.

Le Mystere de la Vengeance de Notre Seigneur J. Christ, 2 vols. folio, M. S. L.493, 10s. Mr Payne.

Shakespeare's Plays, folio, 1623. L.100, Mr Nornaville.

A Collection of Prints of Theatrical Scenes and Portraits of Performers, 8 vols. folio. L.102, 12s.

The Nice Wanton, a Comedy, 4to, 1573. L 20, 9s. 6d. Mr Nicol.

Marlow and Nash's Tragedy of Dido, 1594. L.17, 17s. Mr Heber.

Morlini Novellæ, 4to, Neapolis, 1520. L.48, Mr Triphook.

Recueil des Romans des Chevaliers de la Table Ronde, 3 vols. folio, an ancient manuscript. L.78, 15s. Mr Triphook.

Le Romant de Fier a Bras le Geant, folio, Genev. 1478. L.38, 17s. Mr Triphook.

Recueil des Histoires de Troyes, par Raoul Le Fevre, folio. L.116, 11s. Lord Spencer.

Il Decamerone di Boccacio, folio, first edition, printed at Venice by Valdarfer, 1471. L.2260, Marquis of Blandford.

The Boke of the Fayt of Armes and of Chyvalrye printed by Caxton. L.336, Mr Nornaville.

The veray trew History of Jason. L.94, 10s. Mr Ridgway.

The Recuyell of the Historyes of Troye, by Raoul Le Fevre. Caxton, 1471. L.1060, Mr Ridgway.

History of the Noble Appolyn, 4to. L.110, Mr Nornaville.

History of Blanchardyn and Eglantyne; printed by Caxton. L.215, 5s. Lord Spencer.

Delphin Classics, 67 vols. L.504, Duke of Norfolk.

The prevalence of bibliomania is not unknown in France, as will appear from the extraordinary prices of the following books at the sale of Count Macarthy's library in Paris, in 1816:

Psalmorum Codex, fol. *Mogunt.* 1457, 12,000 francs.

Psalmorum Codex, fol. *Mogunt.* 1459, 3350 francs.

G. Durandi Rationale Divinorum Officiorum, fol. *Mogunt.* 1459, 2000 francs.

Speculum Humanæ Salvationis, folio, 1320 francs, (sold in 1769 for 1600 francs.)

Historia Beatæ Mariæ Virginis, per figuras, folio, 1560 francs, (sold in 1769 for 352 francs.)

Ciceronis Officiorum, Libri III. fol. *Mogunt.* 1466, 1190 francs.

Biblia in Lingua Vulgari, 2 vols. folio, 1471, 1199 francs, (sold in 1784 for 720 francs.)

Virgilii Opera, folio, 1472, 2440 francs.

Euripidis Opera, studio Jos. Barnes, fol. *Cantab.* 1694, 1800 francs.

Xenophontis Opera, 6 vols. 8vo, large paper, Oxon. 1703, 1960 francs.

Xenophontis Cyropædia, fol. Oxon. 1728, et Xenophontis de Cyri Expeditione, Lib. VII. folio, Oxon. 1735, large paper, 2550 francs.

Thuani Historia, 7 tom. fol. bound in 14 vols. fol. London, 1733, 1225 francs.

The enormous prices of books on natural history which have issued from the French press in the present day, are worthy of being recorded as a literary curiosity. Various editions of Buffon's Natural History have appeared at Paris between the years 1799 and 1804, from L.6 to L 50; the edition by Sonnini, in 123 volumes 8vo, with coloured figures, is stated at L.100; and another, with original designs and coloured figures by the most eminent artists, in 80 volumes 18mo, is set down at the extraordinary price of L.500. Duhamel's Treatise on Trees and Shrubs, in five volumes folio, with engravings, beautifully coloured, is marked at L.150. Le Vaillant's Natural History of Parroquets is L.45; the Natural History of Birds of Paradise, Rollers, &c. by the same author, is L.150; Rousseau's Letters on Botany, large folio, with coloured engravings from the drawings of Redouté, is L.20; and one copy of the same work, with the original drawings of that celebrated artist, stands conspicuous in bibliographical history. It is set down in the catalogue of M. Bossange and Masson at L.1000.

The reader who is desirous of indulging his taste for inquiries into this department of literary history, will find it amply gratified by consulting Dibdin's *Bibliomania*, or "Book Madness," a singular production, and richly stored with amusing anecdotes.

BOOK-BINDING, is the art of sewing together the sheets of a book, for the purpose of securing them from injury, and, at the same time, of admitting the convenient perusal of their contents. The origin of book-binding, which, in some form or other, must be nearly coeval with the invention of letters and the composition of books, is ascribed to Phillatius, a learned man of Athens, who is said to have first taught the use of a kind of glue for fastening the leaves together; and for this valuable discovery a statue was erected to his memory by his grateful countrymen.

The leaves of books are put together or secured in various ways. When they are merely sewed together, the operation is called *stitching*, which is usually practised with pamphlets, and, for temporary convenience, with larger works. In *half-binding*, the edges of the leaves are generally left uncut, the back only is covered with leather, and the pasteboard sides are covered with marbled or coloured paper. Different kinds of binding are distinguished by different names. In Dutch binding, the backs of the books are of vellum; and in French binding a slip of parchment is applied over the back, between each band, and the ends are pasted on the inside of each pasteboard. This method of binding, technically called *indorsing*, is peculiar to the French binders, who are required by a particular regulation, under the sanction of a penalty, to practise it. Binding in parchment, in sheep, in calf's leather, and in Russia, Morocco, &c. by which the nature of the material with which the book is covered is designated, are familiar terms in this art.

The most ancient method of binding books in volumes was that of glueing the leaves together, and rolling them on cylindrical pieces of wood; this is called Egyptian binding, and it is now altogether disused, except in Jewish synagogues, where the books of the law are written on vellum, and sewed together, constituting one long page, which has a roller at each extremity, furnished with clasps of gold or silver. The invention of square binding, which is now generally practised, and in which the sheets are laid over each other, is ascribed to a king of Pergamus, to whom the world, it is said, is also indebted for the method of preparing parchment.

Folding, &c.—The preliminary operation in book-binding is, to fold the sheets according to the form in which they have been printed, namely, in two leaves, for folios, four for quartos, eight for octavos, &c. A folding-stick, as it is called, which is a thin slip of ivory, or bone, or hard wood, is employed for this purpose. The letters and numbers at the bottom of the pages, technically denominated signatures, direct the workmen in the proper arrangement of the sheets. The leaves being folded and disposed in the order of the signatures, are beaten with a heavy hammer on a stone, to make them smooth and solid, and they are afterwards pressed: they are then sewed in a sewing press on cords, or packthreads, or bands, at a proper distance from each other, and in a convenient number. Beginning with the first band, and proceeding to the last, the workman draws a thread through the middle of each sheet, and turns it round the bands. The number of bands, which varies according to the size of the book, is usually six for folios, and five for quartos, octavos, and the rest. When the back of the book is intended to be smooth, as is frequently the case in the binding of the present day, a saw is employed to make places for the bands, so that they are sunk in the paper. The back of the book is then glued, and the ends of the bands being opened, are scraped with a knife, for the more convenient fixing of the pasteboard sides; the back is then turned with a hammer, the book being fixed in a press between backing boards, for the purpose of making a groove for admitting the pasteboard sides; when the boards are applied, holes are made in them, through which the bands are drawn, the superfluous ends of which are cut off, and the parts are hammered smooth.

Cutting the edges, &c.—After the operations now described are completed, the book is pressed for cutting; this is performed by an instrument called a plough, to which a knife is attached; it is placed in the cutting press between two boards, one of which is even with the press for the knife to run upon, and the other rises above it for the knife to cut against; the pasteboards are then squared with a proper pair of iron shears, after which the book is ready for sprinkling, blacking, marbling, or gilding the leaves. Vermilion or sap-green is usually employed for sprinkling the leaves, which is performed with a brush of hogs bristles, the brush being held in one hand, and the hair being moved with the other.

Gilding the edges.—When the edges are intended to be gilt, it is placed in a press between two boards, and first scraped with a knife called the scraper, and then with another called the smoother, that all the scratches may be removed. When it is quite smooth

Bookbinding.

a little yellow ochre is scraped upon it, and, being moistened with a little size-water, is rubbed off with clean shavings. The gilding size is composed of white of eggs mixed with water, and well beaten together, and the leaves being moistened with a brush dipped in the size-water, the gold is laid on and dried before the fire; when it is dry it is burnished with a dog's tooth. When the leaves are blacked, they are first moistened, then rubbed with fine antimony till they are quite dry, and afterwards subjected to the operation of the burnisher, as in gilding.

Covering of books.—The skins employed in the covering of books are prepared by different processes, according to their different qualities. When the cover is of calf skin, it is moistened in water, cut to the size of the book, and the thickness of the edges pared off; the cover is then smeared over with paste, stretched over the pasteboard on the outside, and doubled over the edges within; the book is then firmly bound between two boards, the back is warmed at the fire to soften the glue, and the leather of the back is rubbed down to make it apply close; the book is then dried and uncorded, when it is washed over with a little paste and water, the edges and squares are blackened with ink, and sprinkled or marbled; the cover is then glazed twice with white of egg, filleted plain or with gold, and, last of all, polished with an iron passed hot over the glazed cover. When the book is titled on the back, a piece of Morocco leather, of such colour as may be required, is pasted between the first and second band, to receive the title in gold letters.

Gilding the back and cover.—In common binding, the edges of the cover and the backs of books only are gilt; but books are sometimes splendidly decorated with various figures in gold. Flowers, roses, coats of arms, and other ornaments, are made with gilding instruments engraved in relievo, either on the points, puncheons, as in the case of letters, stars, or small figures, or a round small cylinder of brass, and the like. Those parts of the leather on which the gold is to be applied, are glazed three or four times with size-water, by means of a spunge; when they are nearly dry they are slightly oiled, the pieces of gold leaf are laid on, and the tools are either pressed with the hand, or the cylinders are rolled along the places to be gilt, both instruments being a little heated. The gilding being finished, the redundant gold is rubbed off, and the whole is polished. Gilding on rough leather is performed by means of resin dried and powdered, instead of whites of eggs; the gold leaf, cut to a proper size, is placed on a hot slightly-oiled stamp, and pressed down, and as the resin melts only in those parts where the hot stamp is applied, the other parts of the leather remain as at first.

Improved methods of binding books have been proposed of late years, and the advantages of the improvements have been secured to their inventors by patent; one of these, by Messrs Williams of London, is applied to all kinds of books; and another, by Mr Palmer, is chiefly useful for merchants acccount books. For an account of both, see *Repertory of Arts*, Vol. XIV.

BOOK-KEEPING.

Definition.

Book-keeping is the art of keeping merchants accounts,—the art of recording the transactions of trade, in such a manner that the merchant may be able, at any time, to determine with facility the exact state of his affairs. The mode of doing this being perfectly arbitrary, various methods of book-keeping have been used. We shall here endeavour to explain the principles of what has been termed the *Italian Method*, or *the Method by Double Entry*, as it is the method most universally adopted.

Chap. I. Of the Books.

Object of

The great object of book-keeping is to discover, at any time, what the merchant is worth, and there are two ways in which this may obviously be accomplished, namely, 1*st*, By collecting into one sum the whole amount of his property, and deducting from it the whole amount of his debts; or, 2*dly*, Knowing the amount of his property at any former period, as, for example, at the time he begins business, by adding to or deducting from it the amount of his gain or loss since that time. Now, it has been found necessary in book-keeping to use both these methods, in order that, by arriving at the same conclusion in different ways, we may be the more assured of the accuracy of the result, or, in case of any inaccuracy, that we may perceive the extent of the errors that have been committed.

In every mercantile concern, where the merchant is continually buying and selling, receiving some goods and delivering others in return, receiving from some people on credit, and delivering on credit to others, his property must consist, in a great measure, of the value of the goods delivered on credit, and his debts of the value of the goods received. The amount of his profit or loss also, in the whole of his transactions, must be equal to the total sum of the profits or losses that have arisen by his dealings in each separate article, and these again depend evidently upon the prices at which he buys, and the prices at which he sells the articles. In recording these various transactions, therefore, with the view of readily striking the balance between his debts and his credits, his gains and his losses, it is necessary to adopt a pecu-

Waste-book. liar arrangement. It is necessary, 1*st*, That the *opposite* transactions of giving away and receiving be kept quite distinct from each other; 2*dly*, It is necessary, with the view of ascertaining the state of the merchant's accounts with other people, that the transactions with different *persons* be kept distinct from each other; and, 3*dly*, With the view of shewing the gain or loss in each article, that the transactions in different *articles* be kept distinct from each other.

Leger.—There is, accordingly, in the Italian, as in every other method of book-keeping, a principal book, termed *the Leger*, to the formation of which the other books are only subservient, which contains a complete state of the merchant's affairs, and in which all his transactions are recorded, according to the above arrangement.

Waste-Book.—But in order to secure the insertion of every transaction without exception, it is quite necessary that each of them be entered in the books at the moment, if possible, it takes place; and as it would be very inconvenient, in the hurry of business, to be searching in the leger for the place where every transaction, according to its nature, ought to be inserted, it has been found necessary to make use of another book, termed the *Waste-book*, where each transaction, of whatever description, is entered exactly as it arises, and from whence it is transferred, at leisure, to its proper place in the leger.

Journal.—To make this transference also with greater expedition and accuracy, it has been found necessary to use a third book, termed the *Journal*. The construction of these books we shall now more particularly describe.

Chap. II. Of the Waste-Book.

From what has been said of the nature of this book, its construction will be easily understood. It begins, as in waste-book A, with a full account of the merchant's property, an inventory of every article in his possession, and a list of all the debts due to him, and of all the claims against him, and then proceeds with an account of every transaction that occurs, expressing it in short but intelligible language. It is ruled, as in the example below, from top to bottom, with three columns to the right for *L. s. d.* and one to the left for a margin, the space between these columns being occupied with the dates and narratives of the transactions; the date is written at full length, and in large characters, as the head-line of each page, and in the middle of that line,—ink lines being drawn on each side of it to the margin line on the left, and to the money lines on the right. In dating the transactions of the following days, the day only is written between the opposite ink lines, the month not being repeated in the same page. Lastly, the transactions of the same day are either separated from each other by a line drawn wholly across the page, from the margin to the money columns, or the date is repeated.

Leger.

EXAMPLE.

WASTE-BOOK.

	Edinburgh, January 1. 1816.	L.	s.	d.
	Bought for ready money, 400 yards shaloon, at 1s. 3d.	25	0	0
	3			
	Bought of J. Innes, 18 hhds. wine at L.30,	540	0	0
	3			
	Received of David Jackson, L.100 lent to him, with interest on the same,	104	0	0
	Sold William Keith, 1 pipe of port wine,	90	0	0
	6			
	Bartered with Robert Stevens, 1 pipe of port wine for $1\frac{1}{2}$ ton of madder at L.3 per cwt.	90	0	0

Chap. III. Of the Leger.

Sect. I. *Of the opposite sides of the Leger.*

In the leger, as we have already observed, the transactions entered in the waste-book are arranged in distinct classes.

In the *first* place, they are all arranged according to the opposite relations of buying and selling—of things received and of things delivered. It has therefore been agreed to allot the opposite pages of the leger for inserting the values of articles of these opposite kinds; and, in numbering the pages, these two opposite ones are considered as one folio.

Sect. II. *Of Personal Accounts.*

Secondly, The transactions of the waste-book are arranged in relation to the *persons* with whom they have taken place; the dealings with each person or company being all collected together under one point of view, and under the title of an *account*. These accounts are termed *personal* accounts, and one of them is opened with every person with whom there are any dealings; a certain space is allotted in the leger for receiving this account, and when that space is filled up the account is transferred to another page, where another space is allotted to it.

The object of a personal account is to shew how much the merchant owes that person, or how much the latter owes him; and as this quantity, in every particular transaction, is evidently the difference between the value of what he gives that person and the value of what he receives from him, so in the whole of their transactions with each other it is the difference between the sum total of the values given and the sum total of the values received. In transferring, therefore, the entries of the waste-book to the leger, with the view of ascertaining these sums, we have only to set down carefully, in every personal account, the value of the articles received by each transaction, on that side of the leger which has been allotted to articles bought, and the value of the

Personal Accounts.

articles given by each transaction on the opposite side of the leger, and in the same account; money columns being drawn on the opposite pages to receive these opposite values.

In this manner the state of accounts with Thomas Anderson, according to the transactions narrated in waste-book A, are easily ascertained. Thus,

Goods delivered or sold on credit.		*Goods received or bought on credit.*	
Jan. 15. Paper	L.18 0 0	Mar. 24. Paid in by him to the Royal bank, on	L.40 0 0
Feb. 1. Salt, yarn, and iron, amounting in all to	28 0 5	Amount of goods delivered	73 0 0
Ap. 12. Train oil	27 0 0		
	73 0 5	Difference—the sum due by T. Anderson	L.33 0 0

In forming this balance, it is evidently of no consequence on which of the pages of the leger these opposite quantities are inserted. But it has been agreed to enter goods bought on the left hand page, and goods sold on the opposite. A peculiar form has also been adopted in these entries, as will be seen in Thomas Anderson's account in leger A. The left-hand page has been called the *debtor*, or *Dr.* and the right the *creditor Cr.* or *contra* side of the leger or of the account. In the former is written, at the head of the account, the name of the person in large characters; in the same line of the page the word *Dr.;* and the titles of the articles are preceded by the word *to*, so that the whole reads thus; *Thomas Anderson, Dr. to paper, to oil, to sundries*, and so on, which means nothing more than that these things have been delivered to Thomas Anderson, and that he is accountable for them to the deliverer. On the opposite side of the account, again, which contains articles received from the person, the words *Contra Cr.* are written in a line, with the name and the articles preceded by the word *by ;* so that the whole reads thus, *Contra Cr.* that is to say, *Thomas Anderson, Contra Cr. By Royal bank paid in by him,—By cash*, or *by* any article received. It is doubtful if this technical mode of entering the accounts has any, and at all events it is not necessary that it should have any meaning, further than indicating the opposite sides of the leger—the opposite relations of buying on credit and selling on credit; and though the words *to* and *by* are universally prefixed to the narratives, these opposite relations might equally well have been indicated by the simple terms *Dr.* and *Cr.* which would then have been of the same nature with the signs *plus, minus*, &c. in arithmetic.

But at the time of opening the books, there usually remain unsettled a number of balances of the personal accounts of the former books; these constitute so many debts due to the merchant on the one hand, or by him on the other. Being accordingly all entered in the inventory with which the waste-book begins, they are transferred from it to the accounts of the same persons in the new leger; and as they are evidently of the same nature, the debts due to the merchant as goods sold, and the debts due by him as goods bought, they are entered on the same sides of the accounts respectively, the former on the Dr. or left-hand side, and the latter on the Cr.

Real Accounts.

Sect. III. *Of Real Accounts.*

Thirdly, The transactions in the waste-book are arranged in the leger relatively to the *articles* about which they have taken place, such as goods of all kinds, houses, lands, ships, shares in public companies, and the like; those concerning each article being formed into a separate account. These accounts are called *real accounts*, and their object is to exhibit the gain or loss that has arisen by the dealings in any particular article; and also, by shewing how every article has been disposed of, to satisfy the merchant that nothing has been lost, or to point out the quantity amissing.

If A, for example, buys 100 qrs. of wheat at 80s. a quarter, and sells it again at 90s. he will evidently gain L.50; but if he again buys 100 qrs. at 90s. and is obliged to sell it when the price has fallen to 75s. he will lose L.75 by the latter transaction; but in the two transactions together he will only lose L.25. One object of every real account, therefore, is to shew the total quantity of gain or loss upon a variety of separate transactions in the article to which it relates; and as the gain or loss on any particular transaction is evidently the difference between the price at which we buy (the *prime cost* as it is termed by retail dealers) and the price at which we sell, so the total gain or loss is the difference between the total sum of the prices at which we buy, and the total sum of the prices at which we sell. In transferring, therefore, to the leger the transactions concerning articles, with the view of striking the balance of profit or loss, it is only necessary to set down the value of every article bought on one side of the account, and the value of every article sold on the opposite; by adding these opposite money columns into two sums, and taking the difference between them, we obtain the total gain or loss upon the article in question, viz. the total gain, if the value of articles sold exceeds that of the articles bought, and the total loss if the contrary. In this manner the profit on the dealings in iron, for example, is obtained, as they are narrated in the waste-book A. Thus,

Articles bought.		*Articles sold.*	
Jan. 13. Bought of W. Johnston 320 stones at 3s. 4d.	L.53 6 8	Feb. 1. Sold Tho. Anderson, 100 st. at 3s. 4½d.	L.16 17 6
		Mar. 28. Robertson & Ritchie, 150 at 3s. 7d.	26 17 6
		April 1. Sold for ready money 70 st. at 3s. 6½d.	12 7 11
	L.53 6 8		L.56 2 11
Articles sold	56 2 11		
Difference, the amount of gain	2 15 3		

Real Accounts.

In the above examples we have supposed the goods to have been all bought and all sold; but this is seldom the case, as there is generally a quantity on hand at the time of opening the books, and a quantity unsold at the time of striking the balance; the gain or loss, however, is obtained upon the same principle. A, for example, has on hand at the time of beginning business 100 quarters of wheat, the selling price being then 60s. and at balancing the accounts finds that 50 quarters had been sold at 80s. and 50 at 70s. producing in all L.375. Now, the value of the wheat on hand at opening the books was evidently L.300, the sum for which it could have been then sold, but it was actually sold for L.375, and thus produced a gain of L.75, the difference between these two values.

On the other hand, if none of the goods have been sold, but all remain on hand at the time of balancing, it is clear that the gain or loss on these goods would be the difference between the sum of the prices at which they have been bought, and the price for which they would then sell, that being their value at the time. If A, in the above example had only sold 50 quarters at 80s. leaving on hand 50 quarters at the time of balancing, the price being then 70s. it is evident that his gain on the transactions would be still L.75, for if he did not sell the 50 quarters at 70s. he might have sold them, and that was their value at the time. It appears then, that, in every case, the gain or loss is the difference between two quantities which stand on the opposite sides of the leger, viz.

1*st*, When the goods are all on hand at the time of opening the books, and all sold during their currency, it is the difference between

The price at which they would sell at opening the books, } and { The sum of the prices at which they have been sold.

2*dly*, When the goods are all bought and all sold during the currency of the books, it is the difference between

The sum of the prices at which they have been bought, } and { The sum of the prices at which they have been sold.

3*dly*, When the goods are all bought during the currency of the books, and all remain on hand at the time of balancing, it is the difference between

The sum of the prices at which they have been bought } and { The price at which they would then sell.

Now, every case that can possibly happen is made up of these three in different proportions. In general, therefore, and universally, the gain or loss is obtained by adding up, on one side of the leger, the market-price of the goods on hand at opening the books, together with the prices of all that are bought during their currency, and, on the opposite side, the prices of all that are sold during the currency of the books, and the market-price of what remain on hand at balancing; and hence the general rule, to *enter, at their market-price, goods on hand at opening the books on the same side of the leger with goods bought, and goods on hand at balancing on the same side with goods sold.*

Charges on goods.—Any charges on goods, such as carriage, freight, postage, or other incidental expences, tend evidently to diminish the profit which would arise from the sale of them. Thus A buys 100 quarters of wheat at 60s. and, after keeping it a year, sells it at 70s. thus gains, if there were no charges, L.50; but L.5 is paid for granary rent, and L.2 for the interest of money, L.7 therefore must be deducted from the price sold at before it can shew the nett gains by its excess above the price bought at. As in every particular transaction, therefore, all charges must be deducted from the prices of goods sold, so in a variety of transactions all the charges are entered as they arise on the opposite side of the leger, and, being all added up along with goods bought, are all deducted along with them, at one operation from the total value of goods sold.

Advantages.—Any immediate advantage, on the other hand, is entered upon the same principle on the opposite side of the leger along with articles sold.

Quantity columns.—The next object of real accounts is to indicate any deficiency, or the contrary, that may have arisen in any of the articles. This is done by setting down their quantities, that is, their weight, measure, or the like, in an inner column, as well as their values in the outer money column, as in the above example. Thus,

	Bought	Stones.					*Sold*	Stones.			
1816. Jan. 5.	Of Mr Johnston, iron at 3s. 4d.	320	L.53	6	8	Feb. 1.	Thos. Anderson, at 3s. 4½d.	100	L.16	17	6
						Mar. 28.	Robertson and Ritchie, at 3s. 7d.	150	26	17	6
						Apr. 1.	For ready money at 3s. 6½d.	70	12	7	11
		320	L.53	6	8			320	L.56	2	11

The quantities bought being thus equal to the quantities sold, shews clearly that the whole stock has been disposed with nothing lost or missing.

But it frequently happens that the quantities bought, when they come to be minutely examined, turn out sometimes more, but most frequently less, than what they have been entered for, either from erroneous measurements or other causes, on the one hand, or from tear and wear, leakage, or waste of any description, on the other; and these inner columns of quantities, therefore, have the advantage of indicating this excess or defect. For, if there be no error in the entries, in the measurements, or in any other way, the quantities on hand at opening the books, together with the quantities bought during their currency, must be exactly equal to the quantities sold

Real Accounts.

together with the quantities on hand at balancing; and when this equality, therefore, does not take place, it shews clearly an error, which, if not in the entries, must be in the quantities themselves. If the quantity bought and on hand at opening exceeds the quantity sold and on hand at balancing, as in the account of oatmeal in leger A, it shews clearly that there has been an error in the measurement, or that so much has been wasted, lost, or is missing, and the excess is termed *income*, or *amissing*. If, on the other hand, the latter quantity exceeds the former, it shews that the quantities have turned out more than what they were entered for, and, therefore, is entitled *outcome*. But in both cases, as the values of these excesses have been already entered in the money columns, their quantities only are set down in the inner columns, under the titles of income and outcome.

Particular accounts.—We may now mention a few accounts in particular. From what has been said the reader will easily see the reasons of the different entries; and thus guided by the general, and really most obvious principles, on which all accounts are constructed, will have no difficulty with any more complex case that may occur. The general rule is, that every real account must contain, *on the one hand*, 1*st*, *The quantity of the article on hand at the time of opening the books, and its value at the market price;* 2*dly*, *The quantities and values of all that is bought;* and, 3*dly*, *All disadvantages, such as incidental expences:* And, on the other, 1*st*, *The quantities and values sold*; 2*dly*, *The quantity on hand at balancing, and its value at the market-price;* and, 3*dly*, *All advantages, such as drawbacks, bounties, &c.*

Accounts of houses and lands contain, on the one side, the value of the property at the time of opening the books, together with the amount of all the money laid out for repairs, taxes, improvements, or any other species of expence, and also the value of any other property that may have been annexed to it by purchase; on the opposite side, the amount of all money received for rents, for the sale of any part of the produce, or of any part of the property, and also the value of the property at the time of balancing.

In the same manner accounts of ships contain, on the one side, the value of the vessel at opening the books, together with the expences for repairs, for shore-dues and other taxes, for mens' wages, or for any other thing; and, on the opposite side, the amount of all freights or other advantages received.

Accounts of property in the funds, or in public or private companies, contain the value of the share at opening the books, with all the sums paid in, on the one side,—and on the opposite, the amount of all the dividends received.

The account of ready money, termed the *Cash account*, of which the balance shews merely what is on hand or missing, contains the quantity on hand at opening the books, and all sums received, on the one hand,—and, on the other, all sums paid, together with the quantity on hand at balancing. These opposite columns should be alike, else some money has been received or given away which is not accounted for; and thus any loss or incidental gain is indicated.

Besides these and similar accounts, it is necessary to open in the leger an account termed the *Stock account*, in order to exhibit at the time of opening the books the nett amount of the merchant's property. It contains, therefore, on one side, the amount of all his debts, and of all claims upon his property, and on the opposite side the amount of ready money, goods, and property of every kind, together with all his claims upon other people. The balance shews the extent of his stock, or, in case of bankruptcy, the excess of his debts above his funds.

Real Accounts.

Lastly. There is opened in the leger an account termed the *Profit and Loss account*, in which are collected all the articles of gain or loss, in order to shew the general balance upon the whole. It contains, on the one hand, every article of gain which arises during the currency of the books, and is not entered in the other accounts, such as money received by legacy, by commission, insurance, or the like; and, on the other, every article of loss, such as goods destroyed, money paid for interest, for insurance, for warehouse rent, or other expences. At balancing the books also, the total gain or loss arising from all the different accounts is entered on this account, and the balance exhibits the result of the whole. This account, however, contains only the abstract of various other accounts of profit and loss, the details of which it has been found convenient to keep by themselves, and even, in extensive business, to keep in separate books. The following are the principal of these accounts.

The account of *Charges of merchandize*, which contains on the one side all charges incurred in business which have not been entered in the other accounts; and if any should be afterwards so entered, they are not erased from this account, but, what has the same effect, entered again on the opposite side.

The account of Proper expences, which contains on the one side all the money, or any other thing, withdrawn from the business for private use; and there is seldom any thing on the opposite side.

The interest account, the commission account, the insurance account, the account of loss by bad debts, the account of abatements, and various others, are all of the same kind. The account of stock and of profit and loss are sometimes termed fictitious accounts.

Sect. IV. *On Double Entries.*

Such are the principal accounts in the leger. Now, in all these accounts, as well as in the case of personal accounts already noticed, it is obviously of no consequence, in obtaining the balances, on which of the two pages of the leger the different articles be entered, provided those of the same kind be kept on the same page,—articles bought, for example, on one page, and articles sold on the other. Let us see, then, which of them is to be preferred on other accounts. This is a matter of some importance in book-keeping, as on it depends a method of proving the accuracy of the accounts. We may first consider the transactions of buying and selling. In every case of this kind there is the *thing* bought or sold, and the *person* who buys or sells it; and in the above arrangement of leger accounts, *the value*, as we have seen, is entered in the account of the former as well

Double Entries.

as in the account of the latter,—is entered both in the *real* and in the *personal* account to which it relates. In every case of this kind, therefore, the very same quantity is entered twice in the leger.

Now it has been agreed, as we have shewn, to enter the values of articles bought on the *right* hand, or Cr. side, of personal accounts, and the values of articles sold on the left. If in real accounts, therefore, we should enter the values of articles bought, not on the right, but on the *left* hand side of the leger, and also the values of articles sold on the *right*, it would then happen that the value of each article of this kind, without exception, would be entered once on the right of the leger and once on the left. The total sum of the money columns, therefore, of all the right-hand pages, would exactly equal the total sum of the money columns of all the left; and the existence of this equality would prove the accuracy of the entries, while the smallest inequality would indicate with certainty a proportional degree of error.

This arrangement has accordingly been universally adopted in the Italian book-keeping, which has since received the name of the *Double Entry* method. The values of articles bought, which have been agreed to be entered on the *right* of personal accounts, have been also agreed to be invariably entered on the *left* of real accounts; and the terms Dr. and Cr. have been also extended to the latter, the left-hand page being still termed the Dr. and the right-hand the Cr. side of the account. It must not be imagined, however, that these terms have any meaning, farther than to designate the opposite sides of the account. In personal accounts they may perhaps have some analogy to their ordinary acceptation, but in real accounts they have none; and the signs *plus* and *minus* of arithmetic would have equally answered the purpose.

Many articles of the leger, however, are neither bought nor sold from the time of opening to the time of closing the books, and many are not bought or sold at all. But in whatever account any article of this description be entered, there is always, from the nature of leger accounts, another in which it must also be inserted. Thus, goods or money on hand at opening the books, houses, lands, &c. which are entered in real accounts for the purpose of shewing the balance of profit or loss, &c. must also be entered in the account of stock, in order to determine what the merchant is worth. In the same manner, money received or paid must be entered both in the cash account and in the account of the person from whom or to whom, or of the thing on account of which it is received is paid; every article of gain or loss also must be entered on the account of the article, as well as in the account of profit and loss. Thus, in every other transaction, as well as in that of buying and selling, there is also invariably a double entry in the leger. Now, as it is in all cases a matter of perfect indifference, as to the formation of a balance, on which of the two sides of an account all the Dr. and Cr. articles be placed, it has been agreed, as in the case of articles bought and sold, to enter the articles upon the respective sides of the leger, in such a manner that all the double entries may be equally divided between its opposite pages. The sums of the whole of the opposite money columns being in that case exactly alike, the existence of this equality serves to prove the accuracy of the accounts; and as any inequality indicates with certainty an error, we thus obtain a very convenient check upon those mistakes which are so apt to arise in every system of keeping accounts.

Balancing Accounts.

Sect. V. *On the Balancing the Accounts and Closing the Books.*

To enter every article, in this manner, upon the proper side of its account, is the most difficult part of book-keeping; and the Journal has been contrived to facilitate this operation, to smooth the way, as it were, from the waste-book to the leger. Before explaining, however, more particularly the nature of the journal, we shall shew how to balance the accounts in the leger, which may be sufficiently understood without regard to the sides on which the Drs. and Crs. of each account ought to be entered.

Personal accounts.—Whenever accounts are settled with any person, his account in the leger to that period is finished or closed, and a new one opened for future transactions. When the sums of the opposite sides of the account are equal, it shews that the parties are clear with each other, or that there is nothing due on either side. In this case, the account balances itself; it is closed by setting down the equal sums of the opposite money columns opposite to each other, and the new account begins with the first subsequent transaction that occurs. But when the sums of the opposite sides are unequal, the difference shews how much one party is indebted to the other; the account is balanced by adding this difference to the smallest side in order to make it equal or *balance* the other,—and this balance being carried forward, forms the first article of the new account. Thus in A's account with the Royal Bank, the sums of the Dr. and Cr. sides are L.190 and L.400 respectively; the difference between them, L.210, is what A owes the Royal Bank. The account is closed thus,

Royal Bank,	*Dr.*	*Contra,*	*Cr.*
To cash paid	L.190	By cash received	L.400
To balance	210		
	400		400

And the new account begins thus,

Royal Bank,	*Dr.*	*Contra,*	*Cr.*
		By balance of former account	L.210

Real accounts.—Real accounts are balanced in the same manner as personal: When no part of the article remains on hand, if the opposite columns of quantities, and also the opposite money columns, be equal, the account balances itself,—there has been neither gain nor loss, neither outcome nor income,—and it is closed by setting down the equal sums opposite to each other. If part of the article be on hand, it is added, as we have seen, to the creditor side of the account, the quantity in the quantity column, and the market-price in the money column. If the opposite quantity columns be then unequal, the difference is outcome, or income, and is added, under its proper title, to the smallest quantity column of the account. If the opposite money columns be unequal, the difference is the gain or loss, and is added to the smallest money column. The sums of the opposite columns being then equal, the account balances; it is closed by setting down the equal sums opposite to each other, and the new account begins with the quantity on hand. The manner of thus closing the account, and entering the different quantities, will appear in the example of oatmeal, leger A.

Oatmeal,	Bolls	*Dr.*			*Contra,*	Bolls	*Cr.*		
The sum of the articles on this side is - - -	130	L.133	13	0	Sum of articles on this side	114	L.143	9	0
To profit and loss for gain		33	1	0	By balance on hand at 30s.	$15\frac{1}{2}$	23	5	0
					Missing - - - - - - -	$\frac{1}{2}$			
	130	L.166	14	0		130	L.166	14	0

The new account begins thus:—

Oatmeal,	Bolls	*Dr.*			*Contra,*	Bolls			
To balance on hand by former account, at 30s. -	$15\frac{1}{2}$	L.23	5	0					

In the same manner, the cash-account is balanced by adding the difference, if any, between the opposite money columns, to that which is the least;—this difference shews the account of cash on hand, and its agreement with what is actually on hand serves to prove the accuracy of the account.

General balance.—Few of the real, or even of the personal accounts, however, are closed until the time of forming the general balance of the books, which it is usual among merchants to do once a-year. This operation is merely the collection of all the scattered balances into one general result, in order that, by finding the total gain or loss on the whole of the transactions, and also the total amount of debts owing to or by him, the merchant may be thus enabled to determine the exact amount of his property. The first thing to be done in balancing the books, after settling all the small accounts and charges in the business, and taking an exact inventory of the goods on hand at their market-prices, is to prove the accuracy of the leger-entries, by forming what is called *the trial balance.* This is done by adding into one sum the whole of the Dr. money columns, and into another the whole of the Cr. If the two sums be equal, the accounts are correct; if unequal, they must be carefully examined until the error be discovered. The next object is to add together all the balances. Those of personal accounts are collected in a separate paper, termed the *balance-sheet,*—the balances due to the merchant on one side, and by him on the opposite. The balance-sheet contains, also from the inventory, the value of every article of property on hand, including cash. The balances of real accounts are also collected on a separate paper, termed the *profit and loss sheet,* those of profit on one side, and of loss on the opposite. The difference between the opposite sides of the balance-sheet then shews evidently what the merchant is worth. The difference between the opposite sides of the profit and loss sheet is the total gain or loss; and this being added or taken from the nett amount of his property at the time of opening the books, shews also what the merchant is worth. When the two results, thus obtained by methods so totally independent of each other, agree together, it affords the strongest proof of the accuracy of the accounts. If they do not agree, it shews that some error has been committed; and the accounts must be all re-examined in order to discover it, or at any rate to bring the two results as near to each other as possible. In an extensive business, it is seldom that they come out exactly alike; but as the difference between them is always the extreme limit of the error, it forms a very convenient measure of the accuracy of the books; and, therefore, when this difference has, by repeated examinations, been reduced to a trifling amount, the error is neglected, and the balance is effected by making profit and loss Dr. or Cr. for the amount.

Closing the books.—Having thus ascertained the exact state of the business as nearly as circumstances will admit, or as there is any occasion for, the next object is to close all the accounts. Real and personal accounts are closed in the manner already stated; and there only remains, after these, the accounts of stock and of profit and loss. The stock account, as we have seen, contains, on one side, the property of the merchant, or the debts due him, and on the other the debts which he owes. By adding to, or taking from the former the nett gain or loss, and adding to the latter the nett stock at the time of closing the books, the opposite sides become equal, and the account is balanced. Thus from leger A.

Stock, *Dr.*				*Contra,* *Cr.*			
To Royal Bank, per account	L.250	0	0	By sundries	L.973	0	0
To balance account for nett stock	735	13	1	By profit and loss for nett gain	12	13	1
	L.985	13	1		L.985	13	1

The reason of this is obvious; for L.973, being the amount of property and debts due, just exceeds the nett stock at opening the books by L.250, the debts then owing. By adding the gain L.12, 13s. 1d. we obtain L.985, 13s. 1d. the nett stock at balancing, together with the same L.250; by adding, therefore, the nett stock at balancing to L.250, it is clear that we obtain the same quantity, L.985, 13s. 1d.

To the profit and loss account in the leger is car-

Journal. ried the amount of the profit and loss sheet; the difference between the sums of the Dr. and Cr. sides is then the total gain or loss; and being added to the smallest side, the account balances, and is closed, like the rest, by setting the opposite sums opposite to each other. In this manner, the whole of the leger accounts are closed, and every thing is prepared for opening a new series. We have now only to explain the forms and rules for entries in the journal.

Chap. IV. Of the Journal.

The journal is either kept separately, or, what is far more convenient, it forms, along with the waste-book, the opposite pages of the same book. It is ruled and dated in the same manner as the waste-book. The entries, as they refer to the same transactions, are made in the same order, and, if upon opposite pages, exactly opposite each other; and on the left-hand margin are written, for the sake of reference, the folios of the leger to which the articles are carried.

Form of entries.—The only object of the journal is to shew, upon inspection, in what account, and on what side of the account or of the leger the value of each article should be placed. The account is indicated by writing its title, that is to say, the name of the person or thing to which it relates, and the side of the account is marked by writing for the Dr. side the word Dr. after the title, and for the Cr. side the word *to* before it. Thus, if the value of an article were to be entered on the Dr. side of A's account, and on the Cr. side of some real account, suppose cash, the journal *entry*, as it is termed, would run thus, *A. Dr. to cash*; then follows a short account of the transaction, called *the narrative*, but which may be omitted if the journal occupies the opposite page with the waste-book, as the narrative of the latter will then be sufficient. In the same manner, the transaction in waste-book A, of January 3, viz. Sold James Spiers 30 bolls of oatmeal at 20s. 6d. is thus *posted*, as it is termed, into the journal. *J. Spiers Dr. to Oatmeal*, sold him 30 bolls at 20s. 6d.; and the meaning of this journal post is, that the value of the meal must be entered on the Dr. side of J. Spier's account, and the Cr. of the account of oatmeal. When there are more Drs. and Crs. than one, the entry in the journal is termed a *complex post*. Thus:

Jan. 13. Bought of William Johnston, merchant, Leith,

200 bush. salt, at 1s. 8d.	L.16 13 4	
320 stones of iron, at 3s. 4d.	53 6 8	
		L.70 0 0

This transaction is either entered thus:

Salt Dr. to Wm. Johnston for
200 bush. at 1s. 8d. L.16 13 4

Iron Dr. to Wm. Johnston for
320 st. at 3s. 4d. L.53 6 8

Or thus, at once, by uniting the two or more Drs. under the term *sundries*:

Sundries Dr. to Wm. Johnston.

Salt for 200 bush. at 1s. 8d.	L.16 13 4	
Iron for 320 stones at 3s. 4d.	53 6 8	
		L.70 0 0

and in this form there is only one entry on Wm. Johnston's account.

Nature of entries.—Such is the method of indicating any account whatever, and any side of that account; but the great thing is to be able to decide, with facility, from the nature of the transaction in the waste-book, the particular account, and, what is most difficult, the proper side of that account on which the value of the article should be placed. As the latter depends entirely upon the conventional arrangement of leger accounts, which we have already described, and of which the object is to obtain a trial balance in the leger, it is only by considering the nature of this arrangement that any general rules for these journal entries can be drawn. Journal.

The transactions of trade which are entered in the waste-book relate,

1st, To things received into, or delivered out of the merchant's possession, and to the persons from whom they have been received, or to whom delivered.

2d, To things on hand at opening the books.

In order to deduce rules for each of these cases, we must consider the nature of the accounts already described. In regard to the first case, we have seen that *personal* and *real* accounts contain, on the one hand, things received, and, on the other, things delivered; and that, as it has been agreed in personal accounts to enter things received on the Cr. and things delivered on the Dr. side, real accounts must therefore contain, in order to obtain a trial balance, things received, not on the Cr. but on the Dr. and things delivered on the Cr.

In the *stock account* there are no entries during the currency of the books; none, therefore, either of things received or delivered. *The profit and loss* account contains articles of gain or loss, which must clearly consist of things received and of things delivered. Each article is also entered in some real account, and as the latter contains things delivered on the Dr. and things received on the Cr. it is evident that, according to the arrangement which divides the double entries equally between the opposite pages of the leger, the profit and loss account must contain things received, that is, articles of gain on the Dr. and things delivered or articles of loss in the Cr.

The nature of the transactions indicates at once the *particular* account in which the things received or delivered must be entered. If received on credit, they are entered in some real and in some personal account—in the account of the thing received, and of the person from whom received,—on the Dr. of the former therefore, and on the Cr. of the latter. If received from one person on account of another, or on account of some thing, as the rent of a house, or the like, they are entered in the account of the thing received, and of the person or thing on whose account they have been received,—on the Dr. of the former, therefore, and on the Cr. of the latter. If received in exchange for other things, they are entered on the Dr. of the things received, and on the Cr. of the things delivered, or given in exchange; if on account of gain or loss, they are entered in the account of the thing received, and in the account of profit and loss,—on the Dr. of the former, therefore, and the Cr. of the latter. Upon the whole, therefore, and adopting the form for journal entries already described, the following rule for things received may be drawn.

Journal.

The thing received is	Dr.	To the person from whom it is received. To the person or thing on whose account it is received. To the thing given for it. To profit and loss.

The same rule applies in a reverse order to things delivered, thus:

The person to whom the thing is delivered. The person or thing on whose account it is delivered. The thing received for it; or, profit and loss.	Drs.	To the thing delivered.

The application of these rules will be evident from the following examples.

1. Bought of William Maclaren 100 qrs. of wheat at 80s. L.400. Here wheat being the thing received, and William Maclaren the person from whom it is received, the entry is,
   Wheat Dr. to William Maclaren.
2. Received from Alexander Beattie in full, L.60. The entry is here evidently,
   Cash Dr. to Alexander Beattie.
3. Bought for ready money, 20 gallons rum at 20s. L.20. Here *rum*, (the thing received,) is *Dr. to Cash*, (the thing delivered.) In the same manner in the following:
   Bartered 10 doz. port wine at 30s. for 15 gallons rum at 20s.; the entry is,
   Rum Dr. to Port Wine.
4. Paid for repairs to my house in Queen's Street, L.30. Here *House in Queen's Street*, (on account of which the thing is delivered,) is *Dr. to Cash*, (the thing delivered.) In the same manner are entered the following:
   Paid for shop rent L.10.
   Profit and Loss Dr. to Cash paid for shop rent.
   Received rent of house in Queen's Street, L.70.
   Cash Dr. to house in Queen's Street, (the thing on whose account the money is received.)
   Received 100 bolls of oatmeal, being the rent of my farm of Braehead,
   Oatmeal Dr. to farm of Braehead.
   Taken for the use of my house, 1 doz. port wine,
   Profit and Loss Dr. to Port Wine, (the thing delivered, or withdrawn from the business.)
   Received in a legacy L.100.
   Cash Dr. to Profit and Loss.

In the above transactions, things received or delivered on credit are entered in the accounts of the things; but in many cases debts are incurred for things which have no accounts in the leger,—as for services in the business, expences for articles, such as houses, ships, &c. interest of money, insurance, or the like, on the latter of which also debts become due to the merchant. These, however, are entered in the same manner, only substituting for things received the persons indebted to the merchant on account of them, and for things delivered the persons to whom the value is due, according to the following rules:

The person who owes, or is accountable for the thing, is	Dr.	To the thing given. To the person or thing on whose account it is given, or to profit and loss.
The thing received. The person or thing on whose account it is received, or profit & loss,	Drs.	To the person to whom the value is due.

Thus the following are entered:

William Burnet owes me rent of my house in Princes Street—
William Burnet, Dr. to House in Princes Street.
David Dobson owes me L.10 for interest of L.200—
David Dobson, Dr. to Profit and Loss.
Due William Davidson, my clerk, for wages, L.20—
Profit and Loss, Dr. to William Davidson.
Due David Henderson for repairs on the ship Elizabeth—
Ship Elizabeth, Dr. to David Henderson.

In some cases things are delivered by one person to another on the merchant's account. Thus, Thomas Anderson has paid the Royal Bank on my account L.40. Here the effect is the same as if there had been a double transaction,—as if Thomas Anderson had paid the merchant L.40, and the latter paid it to the Royal Bank, for which there would evidently have been the following entries:

Cash Dr. to Thomas Anderson.
Royal Bank Dr. to Cash.

But instead of making four entries in the leger, it is sufficient to enter the quantity in the accounts of the Royal Bank and of Thomas Anderson, omitting entirely the two entries on the opposite side of the cash account, which can have no effect whatever upon the balance. In that case the entry will run thus:

Royal Bank Dr. to Thomas Anderson:

And the rule will be, that

The person to whom any thing is delivered on the merchant's account,	Dr.	To the person who delivers it.

Things on hand at opening the books, and debts due to or by the merchant, are all entered in the inventory in the waste-book, from which they are transferred to the journal, and from the latter they are entered in the leger, the former in real, the latter in personal accounts, and all of them in the stock-account. Things on hand are entered, as we have seen, on the Dr. of real accounts; they must therefore be entered on the Cr. of stock. In the same manner, debts due to or by the merchant, which are entered, the former on the Dr. the latter on the Cr. of personal accounts, must be entered in the stock-account, the former on the Cr. the latter on the Dr. Hence the following rules.

The things on hand. The persons indebted to the merchant,		Drs. to Stock.
Stock,		Dr. to the persons to whom the merchant is indebted.

The application of these rules is sufficiently exemplified in the beginning of journal A.

In closing the books in the manner already described, the most regular way is to enter the results of the balance account in the journal. Thus, in order to close the real and personal accounts, the entries will be, for the profit and loss sheet,

Waste-book.

Profit and Loss Dr. to Sundries for articles of loss.
Sundries Dr. to Profit and Loss for articles of gain.
And for the balance sheet,
Balance Account Dr. to Sundries for articles belonging to me.
Sundries Dr. to Balance Account for articles due by me
And in order to close the accounts of stock, and of profit and loss, the entries are,
Profit and Loss Dr. to Stock for nett gain.
Stock Dr. to Balance Account for nett stock.

These entries are exemplified in Journal A, and balance account.

The above rules comprehend all the transactions of ordinary business; as illustrating also the general principles on which all journal posts are formed, they afford the means of forming with ease the proper entries of any more complex transactions that may occur; and, along with what has been said in the preceding chapters and the following specimen of books, will be sufficient to make the reader fully acquainted both with the theory and practice of this useful art.

Journal.

Besides the waste-book and journal, a variety of *subsidiary* books are opened in every extensive business to facilitate the composition of the leger, such as the cash-book, the bill-book, the books of accounts and invoices, the letter-book, &c.; these books contain all the details of the business which it would be inconvenient to enter in the others. Their nature is sufficiently obvious from their titles; and as their forms are quite arbitrary, we need not describe them more particularly.

(1.) WASTE-BOOK A.

Edinburgh, January 1. 1800.

				L.	s.	d.
INVENTORY of ready money goods and debts taken by me, A. B. this day.						
Ready money - -	L. 85	0	0			
100 bolls of oatmeal, at 20s.	100	0	0			
46 reams of paper, at 10s.	23	0	0			
120 sp. five-hank yarn, at 2s. 3d.	13	10	0			
A house in Prince's-street, value	700	0	0			
Wm. Macdonald, merchant, Dundee, owes per account -	50	0	0			
				971	10	--
I owe the Royal Bank, per account -				250	--	--
——3.——						
Sold James Spiers, merchant, Leith, 30 bolls of oatmeal, at 20s. 6d. - -				30	15	--
——5.——						
Bartered 60 sp. five-hank yarn, at 2s. 4d. for 80 yards diaper, at 1s. 9d. -				7	--	--
——13.——						
Bought of William Johnston, merchant, Leith, 200 bush. salt, at 1s. 8d. -	L.16	13	4			
320 stones iron, at 3s. 4d.	53	6	8			
				70	--	--
——15.——						
Sold Thomas Anderson, merchant, Edinburgh, 30 reams of paper, at 12s. -	L.18	--	--			
5 ditto for ready money, at 11s.	2	15	--			
				20	15	--
——18.——						
Sold George Cooper, merchant, Musselburgh, 150 bush. salt, at 1s. 9d. - - -				13	2	6
Received in part L.10, - - -				10	--	--
——18.——						
Paid the Royal Bank - -				100	--	--
——26.——						
Bought of William Macdonald, merchant, Dundee, 500 sp. 4-hank yarn, at 1s. 11d.	L.47	18	4			
Paid him in part -	15	--	--			
				47	18	4
And the balance due him is	L.32	18	4			

(1.) JOURNAL A.

Edinburgh, January 1, 1800.

				L.	s.	d.
Sundries Dr. to Stock for property belonging to me, A. B.						
Cash on hand - -	L.85	--	--			
Oatmeal, for 100 bolls, at 20s.	100	--	--			
Paper, for 46 reams, at 10s. -	23	--	--			
Yarn, for 120 sp. 5-hank, at 2s. 3d.	13	10	--			
House in Prince's street, value	700	--	--			
William Macdonald, merchant, Dundee, per account, -	50	--	--			
				971	10	--
Stock Dr. to Royal Bank, -				250	--	--
——3.——						
James Spiers, merchant, Leith, *Dr. to Oatmeal*, sold him 30 bolls, at 20s. 6d.				30	15	-
——5.——						
Diaper Dr. to Yarn, bartered 60 sp. five-hank, at 2s. 4d. for 80 yards, at 1s. 9d.				7	--	--
——13.——						
Sundries, Dr. to William Johnston,						
Salt, for 200 bush. at 1s. 8d.	L.16	13	4			
Iron, for 320 stones, at 3s. 4d.	53	6	8			
				70	-	--
——15.——						
Sundries Dr. to Paper.						
Thomas Anderson, merchant, Edinr. for 30 reams, at 12s.	L.18	--	--			
Cash for 5 reams, at 11s. -	2	15	0			
				20	15	--
——18.——						
George Cooper, merchant, Musselburgh, *Dr. to Salt*, for 150 bush. at 1s. 9d.				13	2	6
Cash Dr. to George Cooper, received in part - -				10	--	--
——18.——						
Royal Bank *Dr. to Cash* paid them				100	--	--
——26.——						
Yarn Dr. to William Macdonald, merchant, Dundee, for 500 sp. 4-hank, at 1s. 11d.				47	18	4
William Macdonald, Dr. to Cash paid him,				15	--	--

Waste-book.

(2) WASTE-BOOK A.

Edinburgh, February 1. 1800.

	L.	s.	d.
Sold Thomas Anderson 50 bushels salt, being the remainder, at 1s. 8½d. L.4 5 5			
60 spindles five-hank yarn at 2s. 3½d. - 6 17 6			
100 stones iron, at 3s. 4½d. 16 17 6	28	0	5
—— 3. ——			
Received from J. Spiers, in part	20	--	--
—— 10. ——			
Bartered 10 reams of paper at 12s. - - L.6 -- --			
30 bolls of meal, at 25s. - 37 10 --	43	10	--
For 435 spindles, four-hank yarn, at 2s.			
—— 13. ——			
Taken for use of my counting-house, the remaining ream of paper -	--	10	6
—— 15. ——			
Received from Geo. Cooper, in full - - L.10 -- --			
from William Macdonald, in part - 40 -- --	50	--	--
—— 15. ——			
Paid the Royal Bank -	50	--	--
—— 20. ——			
Sold 10 bolls oatmeal for ready money, at 26s. - - -	13	--	--
8 to Geo. Cooper, at 28s. L.11 4 --			
12 to Robertson and Ritchie, at 28s. - - 16 16 --	28	--	--
—— 22. ——			
Drawn on Royal Bank -	100	--	--
Paid William Johnston in part L.50 -- --			
William Macdonald 15 -- --	65	--	--
—— *March* 1, 1800. ——			
Paid charges and cellar rent of salt - - L.1 2 6			
charges and granary rent of meal - 3 3 --	4	5	6
—— 24. ——			
Thomas Anderson has paid the Royal Bank on my account -	40	--	--
—— 28. ——			
Sold Robertson and Ritchie 150 stones iron, at 3s. 7d. - -	26	17	6
—— *April* 1. ——			
Sold for ready money 50 yards diaper, at 1s. 11d. L.4 15 10			
12 bolls oatmeal, at 30s. 18 -- --			
70 stones iron, at 3s. 6½d. 12 7 11	35	3	9

Journal.

(2) JOURNAL A.

Edinburgh, February 1. 1800.

	L.	s.	d.
Thomas Anderson, Dr. to sundries sold him.			
To salt, for 50 bushels, at 1s. 8½d. - L.4 5 5			
To yarn, for 60 spindles five-hank, at 2s. 3½d. - 6 17 6			
To iron, for 100 stones at 3s. 4½d. 16 17 6	28	--	5
—— 3. ——			
Cash Dr. to J. Spiers, received in part	20	--	--
—— 10. ——			
Yarn, Dr. to Sundries, for 435 spindles 4-hank, at 2s. - -			
To paper, for 10 reams at 12s. L.6 -- --			
To meal, for 30 bolls, at 25s. 37 10 --	43	10	--
—— 13. ——			
Profit and Loss Dr. to Paper, taken for use of counting-house -	--	10	6
—— 15. ——			
Cash Dr. to Sundries.			
To Geo. Cooper, in full . L.10 -- --			
To William Macdonald, in part 40 -- --	50	--	--
—— 15. ——			
Royal Bank Dr. to Cash, paid them	50	--	--
—— 20. ——			
Sundries Drs. to Oatmeal.			
Cash for 10 bolls at 26s. -	13	--	--
Geo. Cooper for 8 bolls at 28s. L.11 4 --			
Robertson and Ritchie, for 12 bolls, at 28s. - 16 16 --	28	--	--
—— 22. ——			
Cash Dr. to Royal Bank, drawn on them	100	--	--
Sundries, Drs. to Cash. -			
William Johnston, paid him L.50 -- --			
William Macdonald, paid him 15 -- --	65	--	--
—— *March* 1. 1800. ——			
Sundries Drs. to Cash.			
Salt, for charges and cellar rent L.1 2 6			
Meal, for charges and granary rent - - 3 3 --	4	5	6
—— 24. ——			
Royal Bank Dr. to Thomas Anderson.			
Paid them by him on my account	40	--	--
—— 28. ——			
Robertson and Ritchie Dr. to Iron, for 150 st. at 3s. 7d. - - -	26	17	6
—— *April* 1. ——			
Cash Dr. to Sundries.			
To diaper, for 50 yards, at 1s. 11d. L.4 15 10			
To oatmeal, for 12 bolls, at 30s. 18 -- --			
To iron, for 70 stones, at 3s. 6½d. 12 7 11	35	3	9

Waste-book.

(3) WASTE-BOOK A.

Edinburgh, April 7, 1800.

		L.	s.	d.
Bought for ready money,				
30 casks train oil, at 22s.	L.33 -- --			
10 bolls meal, at 20s.	10 -- --			
20 ditto, at 20s. 6d.	20 10 --			
		63	10	--
— 12. —				
Sold Thomas Anderson 20 casks train oil, at 27s.		27	--	--
— 15. —				
Sold David Dunlop of Stirling, 10 casks train oil, at 28s.	L.14 -- --			
12 bolls oatmeal, at 27s.	16 4 --			
		30	4	--
Received in part		10	--	--
— 23. —				
Paid for small charges in my business since January 1st	L.5 3 8			
Personal and family expences	32 -- --			
J. Davidson, my clerk, for wages	5 -- --			
		42	3	8
Inventory of goods and other effects belonging to me at the time of balancing my books:				
15½ bolls meal, at 30s.	L.23 5 --			
953 sp. yarn, at 2s. 1d.	99 3 5			
32 yds. diaper, at 2s.	3 4 --			
	L.125 12 5			
House in Prince's street	700 -- --			
	L.875 12 5			

Journal.

(3) JOURNAL A.

Edinburgh, April 7, 1800.

		L.	s.	d.
Sundries Drs. to Cash.				
Train oil, for 30 casks, at 22s.	L.33 -- --			
Oatmeal, for 10 bolls, at 20s.	10 -- --			
for 20 ditto, at 20s. 6d.	20 10 --			
		63	10	--
— 12. —				
Thomas Anderson Dr. to Train Oil, for 20 casks, at 27s.		27	--	--
— 15. —				
David Dunlop of Stirling, Dr. to Sundries.				
To train oil, for 10 casks, at 28s.	L.14 -- --			
To oatmeal, for 12 bolls, at 27s.	16 4 --			
		30	4	--
Cash Dr. to D. Dunlop, received		10	--	--
— 23. —				
Profit and Loss Dr. to Cash, for charges on business and family expences		42	3	8
Profit and Loss Dr. to Salt, for loss			7	11
Sundries Dr. to Profit and Loss for articles of gain:				
Oatmeal	L.33 1 --			
Yarn	8 2 7			
Diaper	-- 19 10			
Iron	2 16 3			
Paper	4 5 6			
Train oil	8 -- --			
		57	5	2
Balance Account Dr. to Sundries, for articles belonging to me:				
To cash	L.35 19 7			
To oatmeal, for 15½ bs. at 30s.	23 5 --			
To yarn, for 953 sp. at 2s. 1d.	99 3 5			
To diaper, for 32 yds. at 2s.	3 4 --			
To Thomas Anderson	33 -- 5			
To George Cooper	4 6 6			
To J. Spiers	10 15 --			
To Robertson and Ritchie	43 13 6			
To D. Dunlop	20 4 --			
To house in Princes street	700 -- --			
		973	11	5
Sundries Drs. to Balance Account for debts due by me:				
By Royal Bank	L.210 -- --			
By William Macdonald	7 18 4			
By William Johnston	20 -- --			
		237	18	4
Profit and Loss Dr. to Stock for nett gain		12	13	1
Stock Dr. to Balance Account for nett stock		735	13	1

LEGER A. (1) | (1) LEGER A.

				£	s.	d.					£	s.	d.
1800		*Stock,* Dr.					1800		*Contra,* Cr.				
Jan.	1	To Royal Bank, per account		£250	--	--	Jan	1	By sundries		£971	10	--
Apr.	30	To balance account for nett stock		735	13	1	Apr.	30	By profit and loss for nett gain		14	3	1
				£985	13	1					£985	13	1

				£	s.	d.					£	s.	d.
1800		*Profit and Loss,* Dr.					1800		*Contra,* Cr.				
Feb.	13	To paper		£ --	10	6							
Apr.	23	To sundries		42	11	7	Apr.	30	By sundries, per J.		£ 57	5	2
Apr.	30	To stock for nett gain		14	3	1							
				£ 57	5	2							

				£	s.	d.					£	s.	d.
1800		*Cash,* Dr.					1800		*Contra,* Cr.				
Jan.	1	To stock on hand		£ 85	--	--	Jan.	18	By Royal bank, paid them		£100	--	--
	15	To paper, for 5 reams		2	15	--		26	By yarn, in part, for 500 spind. 4-hanks		15	--	--
	18	To salt in part		10	--	--	Feb.	15	By Royal Bank, paid them		50	--	--
Feb.	3	To J. Spiers in part		20	--	--		22	By sundries		65	--	--
	15	To sundries		50	--	--	Mar.	1	By sundries		4	5	6
	20	To oatmeal		13	--	--	Apr.	7	By sundries		63	10	--
	22	To Royal Bank, drawn on them		150	--	--		23	By sundries for charges and expences		42	3	8
Apr.	1	To sundries		35	3	9					£339	19	2
	15	To David Dunlop in part		10	--	--	Apr.	30	By balance account		35	19	7
				£375	18	9					£375	18	9

			Bolls.	£	s.	d.				Bolls.	£	s.	d.
1800		*Oatmeal,* Dr.					1800		*Contra,* Cr.				
Jan.	1	To stock on hand at 20s.	100	100	--	--	Jan.	3	By J. Spiers, at 20s. 6d.	30	30	15	--
Mar.	1	To cash paid, charges, and granary rent		3	3	--	Feb.	10	By yarn in barter, at 25s.	30	37	10	--
								20	By sundries	30	41	--	--
Apr.	7	To cash per J.	30	30	10	--	Apr.	1	By cash, at 30s.	12	18	--	--
				133	13	--		15	By David Dunlop, at 27s.	12	16	4	--
Apr.	30	To profit and loss for gain		33	1	--				114	143	9	--
							Apr.	30	By balance account at 30s.	$15\frac{1}{2}$	23	5	--
									Missing	$\frac{1}{2}$			
			130	166	14	--				130	166	14	--

			Spindles.	£	s.	d.				Spindles.	£	s.	d.
1800		*Yarn,* Dr.					1800		*Contra,* Cr.				
Jan.	1	To stock on hand	120	13	10	--	Jan.	5	By diaper in barter for 60 spindles at 2s. 4d.	60	7	--	--
	26	To Wm. Macdonald, at 10s. 11d.	500	47	18	4	Feb.	1	By Thomas Anderson at 2s. $3\frac{1}{2}$d.	60	6	17	6
Feb.	10	To sundries in barter at 2s.	435	43	10	--	Apr.	30	By balance account at 2s. 1d.	953	99	3	5
Apr.	30	To profit and loss for gain		8	2	7							
		Income	18										
			1073	113	0	11				1073	113	--	11

			Yards.	£	s.	d.				Yards.	£	s.	d.
1800		*Diaper,* Dr.					1800		*Contra,* Cr.				
Jan.	5	To yarn in barter, at 1s 9d.	80	7	--	--	Apr.	1	By cash, at 1s. 11d.	50	4	15	10
Apr.	30	To profit and loss for gain		--	19	10		3	By balance account at 2s.	32	3	4	--
		Income	2										
			82	7	19	10				82	7	19	10

			Bushels.	£	s.	d.				Bushels.	£	s.	d.
1800		*Salt,* Dr.					1800		*Contra,* Cr.				
Jan.	13	To William Johnston, at 1s. 8d.	200	16	13	4	Jan.	18	By George Cooper, at 1s. 9d.	150	13	2	6
Mar.	1	To cash paid charges and cellar rent		1	2	6	Feb.	1	By Thomas Anderson, 1s. 8d.	50	4	5	5
			200	17	15	10	Apr.	30	By profit and loss		--	7	11
										200	17	15	10

			Stones.	£	s.	d.				Stones.	£	s.	d.
1800		*Iron,* Dr.					1800		*Contra,* Cr.				
Jan.	23	To William Johnston, at 3s. 4d.	320	53	6	8	Feb.	1	By Thomas Anderson, at 3s. $4\frac{1}{2}$d.	100	16	17	6
							Mar.	28	By Robertson and Ritchie, at 3s. 7d.	150	26	17	6
Apr.	30	To profit and loss for gain		2	16	3	Apr.	1	By cash, at 3s. $6\frac{1}{2}$d.	70	12	7	11
			320	56	2	11				320	56	2	11

LEGER A. (2) | (2) LEGER A.

Date		*Paper,* Dr.	Reams.	£	s.	d.
1800 Jan.	1	To stock on hand at 10s.	46	23	–	–
Apr.	30	To profit and loss for gain		4	5	6
			46	27	5	6

Date		*Contra,* Cr.	Reams.	£	s.	d.
1800 Jan.	15	By Thomas Anderson at 12s.	30	18	--	--
		By cash at 11s.	5	2	15	--
Feb.	10	By yarn in barter at 12s.	10	6	--	--
	13	By profit and loss	1	--	10	6
			46	27	5	6

Date		*Train Oil,* Dr.	£	s.	d.
1800 Apr.	7	To cash for 30 casks at 22s.	33	–	–
	30	To profit and loss for gain	8	–	–
		£	41	–	–

Date		*Contra,* Cr.	£	s.	d.
1800 Apr.	12	By Thomas Anderson, for 20 casks at 27s.	27	--	--
	15	By David Dunlop, for 10 casks at 28s.	14	--	--
		£	41	--	--

Date		*House in Prince's Street,* Dr.	£	s.	d.
1800 Jan.	1	To stock for value	700	–	–

Date		*Contra,* Cr.	£	s.	d.
1800 Apr.	30	By balance account	700	--	--

Date		*Tho. Anderson, Mercht. Edinburgh,* Dr.	£	s.	d.
Jan.	15	To paper, for 30 reams, at 12s.	18	–	–
Feb.	1	To sundries per J.	28	–	5
Apr.	12	To train oil, for 20 casks at 27s.	27	–	–
		£	73	–	5

Date		*Contra,* Cr.	£	s.	d.
1800 Mar.	24	By Royal Bank paid in by him	40	--	--
Apr.	30	By balance account	33	--	5
		£	73	--	5

Date		*George Cooper, Mercht. Musselburgh,* Dr.	£	s.	d.
1800 Jan.	18	To salt, for 150 bushels at 1s. 9d.	13	2	6
Feb.	20	To oatmeal, for 8 bolls, at 28s.	11	4	–
		£	24	6	6

Date		*Contra,* Cr.	£	s.	d.
1800 Jan.	18	By cash	10	--	--
Feb.	15	By cash	10	--	--
		£	20	--	--
Apr.	30	By balance account	4	6	6
		£	24	6	6

Date		*Royal Bank,* Dr.	£	s.	d.
1800 Jan.	18	To cash paid them	100	–	–
Feb.	15	To cash paid them	50	–	–
	24	To Thomas Anderson paid them by him	40	–	–
		£	190	–	–
Apr.	30	To balance account	210	–	–
		£	400	–	–

Date		*Contra,* Cr.	£	s.	d.
1800 Jan.	1	By stock due them, per account	250	--	--
Feb.	22	By cash drawn on them	150	--	--
		£	400	--	--

Date		*Wm. Macdonald, Mercht. Dundee,* Dr.	£	s.	d.
1800 Jan.	1	To stock due by him, per account	50	–	–
	26	To cash in part	15	–	–
Feb.	22	To cash	15	–	–
			80	–	–
Apr.	30	To balance account	7	18	4
		£	87	18	4

Date		*Contra,* Cr.	£	s.	d.
1800 Jan.	15	By cash in part	40	--	--
	26	By yarn, 50 spindles at 1s. 11d.	47	18	4
		£	87	18	4

Date		*James Speirs, Merchant, Leith,* Dr.	£	s.	d.
1800 Jan.	3	To oatmeal, for 30 bolls at 20s. 6d.	30	15	–
		£	30	15	–

Date		*Contra,* Cr.	£	s.	d.
1800 Feb.	3	By cash in part	20	--	--
Apr.	30	By balance account	10	15	--
		£	30	15	--

Date		*Robertson and Ritchie,* Dr.	£	s.	d.
1800 Feb.	20	To oatmeal, for 12 bolls, at 28s.	16	16	–
Mar.	28	To iron, for 150 stones, at 3s. 7d.	26	17	6
		£	43	13	6

Date		*Contra,* Cr.	£	s.	d.
Apr.	30	By balance account £	43	13	6

Date		*Wm. Johnston, Merchant, Leith,* Dr.	£	s.	d.
1800 Feb.	22	To cash paid him	50	–	–
Apr.	30	To balance account	20	–	–
		£	70	–	–

Date		*Contra,* Cr.	£	s.	d.
1800 Jan.	13	By sundries per J.	70	--	--
		£	70	--	--

Date		*David Dunlop, Stirling,* Dr.	£	s.	d.
1800 Apr.	5	To sundries per J.	30	4	–
		£	30	4	–

Date		*Contra,* Cr.	£	s.	d.
Apr.	15	By cash in part	10	--	--
	30	By balance account	20	4	--
		£	30	4	--

COMPUTATIONS.

	Charges Merchandise,	L.	42	14	2	Loss.
Bolls.	*Oatmeal.*					
114	*Cr.* - -	L.	143	9	..	*Cr.*
130	*Dr.*					
16	Difference					
15½	On hand at 30s.		23	5	..	
½	Missing.	L.	166	14	..	
			133	13	..	*Dr.*
		L.	33	1	..	Profit.
Spin.	*Yarn.*					
120	*Cr.* - - -	L.	13	17	6	*Cr.*
1055	*Dr.*					
935			99	3	5	
953	On hand at 2s. 1d.		113	0	11	
18	Outcome.		104	18	4	*Dr.*
	Difference	L.	8	2	7	Profit.
Yards.	*Diaper.*					
50	*Cr.* - -	L.	4	15	10	*Cr.*
80	*Dr.*					
30						
32	On hand at 2s. - -		3	4	..	
2	Outcome.		7	19	10	
			7	..	..	*Dr.*
		L.		19	10	Profit.
Bolls.	*Salt.*					
200	*Cr.* - -	L.	17	7	11	*Cr.*
200	*Dr.* - -		17	15	10	*Dr.*
		L.		7	11	Loss.
Stones.	*Iron.*					
320	*Cr.* - -	L.	56	2	11	*Cr.*
320	*Dr.* - -		53	6	8	*Dr.*
		L.	2	16	3	Profit.
Reams.	*Paper.*					
46	*Cr.* - -	L.	27	5	6	
46	*Dr.* - -		23	..	..	
		L.	4	5	6	Profit.
Casks.	*Train Oil.*					
30	*Cr.* - -	L.	41	..	..	
30	*Dr.* - -		33	..	..	
		L.	8	..	..	Profit.

House in Princes Street,				
Value L.	700	..	..	
Thomas Anderson.				
L.	73	..	5	*Dr.*
	40	..	..	*Cr.*
Owes L.	33	..	5	
George Cooper.				
L.	24	6	6	*Dr.*
	20	..	..	*Cr.*
Owes L.	4	6	6	
Royal Bank.				
L.	190	..	..	*Dr.*
	400	..	..	*Cr.*
Due them L.	210	..	..	
William Macdonald.				
L.	80	..	..	*Dr.*
	87	18	4	*Cr.*
Due him L.	7	18	4	
J. Spiers.				
L.	30	15	..	*Dr.*
	20	..	..	*Cr*
Owes L.	10	15	..	
Robertson and Ritchie.				
L.	43	13	6	*Dr.*
	..	..	..	*Cr.*
Owes L.	43	13	6	
Wm. Johnston.				
L.	50	..	..	*Dr.*
	70	..	..	*Cr.*
Due him L.	20	..	..	
D. Dunlop.				
L.	30	4	..	*Dr.*
	10	..	..	*Cr.*
Owes L.	20	4	..	

Leger.

PROFIT AND LOSS SHEET.

Dr. Loss.		L.	s.	d.
Salt	L.	..	7	11
In ledger		42	14	2
		43	2	1
	Nett gain	14	3	1
	L.	57	5	2

Cr. Profit.		L.	s.	d.
Oatmeal	L.	33	1	..
Yarn		8	2	7
Diaper		..	19	10
Iron		2	16	3
Paper		4	5	6
Train oil		8	..	..
	L.	57	5	2

BALANCE SHEET.

Dr.		L.	s.	d.
Cash	L.	35	19	7
Oatmeal, 15½ bolls at 30s.		23	5	..
Yarn, 953 spindles at 2s. 1d.		99	3	5
Diaper, 32 yards at 2s.		3	4	..
House in Princes street		700	..	..
Thomas Anderson		33	..	5
George Cooper		4	6	6
J. Spiers		10	15	..
Robertson and Ritchie		43	13	6
D. Dunlop		20	4	..
	L.	973	11	5

Cr.		L.	s.	d.
Royal Bank,	L.	210	..	..
William Macdonald		7	18	4
William Johnston		20	..	..
		237	18	4
Stock		735	13	1
	L.	973	11	5

Boors.

BOORS, a general denomination of the Russian peasantry, who are under various degrees of bondage, according to the rank which they hold or the class to which they belong. The boors are divided into two great classes, the first includes the free peasants, who seem to hold a middle place between the free citizens or burghers, and the vassal boors, of which the second class is composed. The free peasants cannot be alienated or sold, they possess property, and, on paying the taxes and performing certain services, are permitted to enjoy the fruits of their labour; they are allowed to educate their children, and are exempted from all authority which is subordinate to that of the sovereign and laws of the state. The class of free peasants comprehends foreign colonists who have settled in Russia as husbandmen; those who are called one-house owners, who possess houses and lands as free property, for which they neither perform any feudal service, nor contribute any portion of their produce, but are bound to furnish recruits, and are prohibited from purchasing in villages, or having vassals as property; the various tribes of Cossacks, Baschkirs, Kalmucks, and the inhabitants of the Steppes in the southern regions of the empire; disbanded soldiers who have fixed their residence in the country; and vassals who have purchased their freedom from their superiors, or obtained it as a reward for their former services.

The vassal peasantry of Russia has been divided into three classes, private boors, boors of the mines, and crown-boors. Those who are included under the first class, belong to individual noblemen, on whose peculiar temper and dispositions their comfort and happiness depend; these private boors are bound to pay a certain sum annually to their masters, and to perform a certain quantity of labour, amounting sometimes to three days in the week; but the quantity of toil and of pecuniary tax being under no particular regulation, depends on the will of the lord. Women, as well as children above ten years of age, are compelled to contribute their share of these oppressive exactions. The boors of the mines are attached to particular establishments, and can neither be sold nor exchanged, but may be transferred to different masters along with the works. The crown-boors enjoy comparatively a much greater degree of freedom and comfort than those belonging to private individuals. The rent or tax exacted by government is generally more moderate; they are permitted to enjoy in security the benefits which arise from their improved condition; and, when they have acquired the means, they are allowed to purchase from noblemen villages and lands, with vassals attached to them. Those who are included in the class of crown-boors are distinguished by different appellations; some are called empire-boors, who seem to be in the rank of citizens, and belong to no particular institution or corporation, but are members of the empire; imperial-boors, who belong to the sovereign or to the court; monastery-boors, who were formerly annexed to the monasteries; and post-boors, who, on condition of keeping post-horses, are exempted from the usual tribute, as well as from other taxes.

Booshuanas.

BOOSHUANAS, a tribe of Caffres in southern Africa, who have arrived at a considerable degree of civilization. The first knowledge of this country and people was obtained in the year 1801, in consequence of an expedition which was sent from the

Cape of Good Hope to explore the interior of that part of Africa. The more recent visit of Mr Campbell, a missionary traveller, has added to the information collected concerning this region, which is represented as populous and fertile. Agriculture is successfully prosecuted, and abundant crops of grain and pulse are raised in inclosed fields. The natives of this country are remarkable for the simplicity of their manners, and are chiefly occupied in attending their cattle and hunting; but the women are very generally employed in the labours of the field.

The first visitors of this part of Africa were not a little surprised by the discovery of a large town, with a population of 10,000 or 15,000 inhabitants, besides many other towns and villages of considerable magnitude. Leetakoo, the chief town, is traversed by a considerable stream; the streets are not without regularity; and the houses, covered with reeds or straw, are of a circular form, and, as they are low, the town occupies a very large space. The inhabitants preserve their grain in jars of baked clay, each of which contains about 100 gallons, is elevated a little above the ground, and is furnished with a round straw roof. The country inhabited by the Booshuanas is included between the 20° and 28° of south latitude, and the town of Leetakoo stands in 26° 30′ of south latitude.

BOOTAN, a mountainous region of northern Hindostan, which is chiefly included between the 27° and 28° of N. lat. is about 200 miles in length, and about 60 or 70 miles in breadth, is separated on the north from Tibet by the Himalaya mountains, and has the province of Bengal for its boundary on the south; and while the unexplored regions north of Assam lie on the east, a district subject to the Nepaulese forms the limit on the west. The remarkable inequalities in the surface of this province produce striking diversities of climate. Of two places within sight of each other, the inhabitants of one, chilled by perpetual snows, experience all the rigours of winter, while those of another are exposed to the burning rays of an almost vertical sun. The mountains of Bootan form part of the great chain which appears in geographical descriptions under the name of Imaus, and which is of frequent occurrence in the mythological histories of the brahmins by the name *Himalaya*, *Himmaleh*, or snowy mountains. On the Bengal frontier, at the foot of this chain, a plain of about twenty-five miles in breadth presents an almost impenetrable mass of the most luxuriant vegetation; the trees are of immense size, and the thick forests, rarely disturbed by mankind, abound with elephants. The less elevated mountains are covered with perpetual verdure; and populous towns and villages are seen rising in the midst of orchards, rich plantations, and fertile fields.

Of mineral substances lime-stone, is chiefly noticed on account of its abundance.

Strawberries, raspberries, and blackberries, grow wild; the apple, the pear, the peach, the apricot, as well as oranges, pomegranates, and walnuts, are cultivated in perfection; and the ash, birch, maple, yew, and pine, and other useful trees, are abundant in the forests. The number of wild animals is small, but a large and handsome kind of monkey, which is held in great veneration by the inhabitants, is abundant; and the horse of Bootan is strong and active.

The robust and active mountaineers of Bootan form a remarkable contrast with their neighbours, the feeble-bodied and meek-spirited natives of Bengal. They are fairer in complexion than the Bengalese, have small eyes, broad faces, and high cheekbones, and are greatly subject to glandular swellings in the throat. In matters of religion the sect of Buddha prevails, and the priests form a distinct class; but the distinction of casts, which is so rigidly observed in Hindostan, is unknown. The supreme head of the province is the Deb Rajah, who resides at Tassudon, the capital, and has under him inferior governors and magistrates.

Woollen cloth for raiment, animal food, spirits, and tea, the latter of which is not less common as a refreshment in Bootan than in China, are in use among the inhabitants. The trade of the province is probably not very extensive, but a caravan annually visits the district of Rungpoor in Bengal, and brings with it oranges, walnuts, and the coarse woollen manufactures of the country, with the horses that carry them, for sale; and among other commodities which were sent by the Rajah of Bootan to the presidency of Bengal, some of the precious metals, as gold and silver, musk, woollen cloths of Tibet, and silks of China, are enumerated, from which it appears that some intercourse exists between this province and those countries.

BOOTON, an island in the Indian ocean near the south-eastern extremity of Celebes, and in 5° of S. lat. is about 85 miles long and 20 miles broad; the surface is high and woody, but in many places is well cultivated, and produces rice, maize, yams, and various tropical fruits; fowls, goats, buffaloes, and fish, are sold to ships which touch at the island; and the inhabitants, who speak the Malay language, and profess the religion of Mahomet, are of a short stature and tawny complexion. The Dutch had formerly a settlement in the bay of Booton, and for the payment of an annual tribute to the chief of the island they were permitted to inspect the woods and destroy the clove trees, that, agreeable to their jealous policy, none but themselves should enjoy the benefit of the trade in that spice. A gulph from the east side of this island has received the name of Mistake-bay, from the extreme difficulty of a ship that has once entered it being extricated, in consequence of the strong currents which constantly flow into it. A Dutch governor, on his passage to Banda, was detained a whole year in this bay.

BOPAL, a town in the province of Malwah, and capital of a territory of the same name in Hindostan. This small state is tributary to the Mahrattas. The town is of considerable extent, surrounded with a stone wall, and secured with a fort built on a solid rock. Under the walls of the fort, a tank, or pond of water, six miles in length, is formed by an embankment at the confluence of five streams which issue from the neighbouring hills. The town and territory of Bopal are occupied by a colony of Patans, to whom they were assigned by Aurengzebe.

BORACIC ACID, a peculiar acid, which forms one of the constituent parts of the native salt borax, and the base of which, *borone*, according to recent discoveries, is analogous to carbone in some of its properties. See Chemistry.

BORACITE, a mineral substance, composed chiefly of magnesia, lime, and boracic acid. See Mineralogy.

BORAGO, Borage, a genus of plants belonging to the Pentandria class.

BORAX, a native salt, which is collected in the East Indies, and is employed in medicine and the arts. See Chemistry and Mineralogy.

BORBONIA, a genus of plants belonging to the Diadelphia class.

BORDA, John Charles, an eminent French mathematician and natural philosopher, was born at Dax, in the department of Landes, in 1733. Having completed his elementary studies, he was placed under the superintendence of the Jesuits, who well knew how to appretiate his talents, and were anxious to number him among their members; but the early and strong bias which he discovered for mathematical researches opposed all solicitation to seduce him to other studies. The father, who had a large family, was desirous that his son should be placed in some situation the emoluments of which might be equal to his support; and with this view the young mathematician reluctantly spent several years in an office connected with the municipal authorities of the country. Relieved from this drudgery, by the advice of a friend, Borda had soon after the good fortune of becoming acquainted with the celebrated D'Alembert, and at his recommendation he entered the French cavalry, and at the same time continued to prosecute his mathematical studies. In his twenty-third year he presented a memoir on the motion of projectiles to the academy of Sciences; in the succeeding year was present at the battle of Hastembeck, where he acted as aid-de-camp; and soon after his return was nominated inspector of the dockyards, an appointment peculiarly suited to his genius and studies. The researches which occupied his attention while he held this office relate to an examination of the theories of the resistance of fluids, the motion of fluids, water-wheels, the construction of water-pumps, and the theory of projectiles.

The application of Borda's mathematical knowledge was now to take a wider range; and, with this view, contrary to ordinary usage, he was appointed an officer in the French navy; and the first service in which he was engaged was, in conjunction with an associate, to try the chronometers, or time-pieces, which were proposed for finding the longitude at sea. This voyage was performed in 1771 and 1772; he was afterwards employed on a survey of the Canary islands, for the purpose of ascertaining their precise position; and he attained the rank of major-general to the armament under the count D'Estaing, who had so large a share in the naval operations of the war which terminated in the separation of America from the parent state. Having obtained afterwards a higher rank in the navy, he was entrusted with the command of several frigates under the orders of the famous count de Grasse, by whom he was appointed to a cruizing station; but his little fleet, after a brave resistance, was compelled to surrender to a British squadron. But the mortification for the loss he had sustained, and the state of his health, which had suffered greatly by long and arduous service, led to the resolution of relinquishing the active duties of the profession, and spending his days in study and retirement. M. Borda seems to have taken an active part in the French Revolution, for he appeared as a candidate for the office of a director of the republic; he had some concern in the improvement of weights and measures; he entered keenly into the grand national schemes for trigonometrical surveys; and he instituted many ingenious experiments on the changes which metallic rods of different kinds sustain by difference of temperature. He died in 1799, when he had reached the 64th year of his age.

BORELLI, John Alphonso, an eminent Italian physician, was a native of Naples, and was born in 1608. Having acquired considerable reputation by his progress in geometrical science during the period of his education, which was completed at Rome, he was appointed to teach mathematics at Messina in Sicily; and during his residence in that island, a malignant fever, which carried off great numbers of the inhabitants, prevailed, and of this fever he afterwards published a detailed account. Borelli held for some time the professorship of philosophy and mathematics at Pisa. He spent the latter years of his life in retirement at Rome, under the patronage, it is said, of queen Christina of Sweden, who then resided in that city; and having reached the 72d year of his age, he died in 1679.

Borelli was highly respected by his cotemporaries; he corresponded on scientific subjects with some of the principal philosophers of the age; and he was the author of numerous treatises on mathematics, natural philosophy, and medicine. But in his most interesting work, *De Motu Animalium*, a posthumous publication, he applies the laws of statics to the motions of living beings. In this elaborate investigation, his object is to estimate, not only the individual, but the collective power of the fibres of a muscle, and to point out the variations in their effects according to the mode of insertion and action.

BORGIA, Cæsar, one of the most conspicuous characters of the concluding part of the fifteenth and the commencement of the sixteenth century, but distinguished by his vices, especially his ambition and cruelty, was the son of cardinal Roderigo, who was raised to the papal throne in 1492, and assumed the name of Alexander VI. The elevation of his father enlarged his ambitious views, and the hope of realizing those schemes of greatness which were suited to his aspiring temper, induced him to appear at the court of the Vatican, for the purpose of securing some share of the power and influence of the head of the church. But although his reception was cold and formal, and his disappointment extreme, yet he was soon after preferred to the archbishopric of Valenza, and in the succeeding year elevated to the dignity of cardinal. The influence attached to the high station which Borgia now filled, rendered him a fit instrument in the hands of a father equally ambitious and depraved, in those political struggles in which he was concerned. Among the first atrocities which marked the flagitious career of Cæsar Borgia, was the death of his brother, who, at his instigation, fell by the hands of assassins, in consequence, it is said, of the marked preference which the father discovered towards his eldest son, or of jealousy in finding him his rival in the affections of a lady to whom he was attached. The father's grief and resentment at this barbarous deed were appeased by a hint from the mother of Borgia, that the same fate, and from the same unseen hand, awaited himself if he should persevere in his enquiries concerning the perpetrators of the murder.

Aspiring to higher distinctions and greater power, Borgia was employed in a mission to the French court in the character of ambassador, was raised to the rank of nobility by Louis XII. with a large pension, and soon after married the daughter of the king of Navarre. He now appeared in a military capacity, and took the command of a party of troops for the purpose of reducing Romagna into subjection to the Holy See. The success of his arms alarmed the Italian states, and produced a confederacy against him; but the cup of poison and the secret blow of the assassin were not less effectual in defeating its object, and in accomplishing the wicked projects of the father and son, than the vigour of open warfare.

The vicious career of this accomplished villain now approached to its termination. To obtain possession of the wealth and property of some bishops, the usual means were resorted to; poison was prepared for the purpose, but the deadly mixture intended for others, by the mistake or design of those who were employed to administer it, was swallowed by the pope and his son. The pope died; but the strength of the son's constitution resisted its effects. Providence seemed to permit him to live, that he might experience adversity and poverty as a punishment for his crimes. Banished from the papal dominions, he narrowly escaped with his life, and found no asylum in any other territory except in the walls of a prison. After two years close confinement in Spain, he escaped from a window by means of a rope; and thus, stripped of all his honours and possessions, degraded and destitute, he fled to his brother-in-law the king of Navarre, who was then at war with some of his rebellious subjects. Borgia entered the service as a volunteer, and was slain in a skirmish in the year 1507; thus leaving to mankind a memorable example of the vicissitudes of fortune, and of the effects of lawless ambition, profligacy, and villainy.

BORING-MACHINE, an apparatus which is employed for the purpose of boring pumps or cylinders, and of rendering their diameters equable and straight. Great precision in the construction, and great accuracy in the operation of such machines, are necessary. The following is a description of an improved boring-machine for the purpose.

A, *Fig* 1. *Plate* 27. is a pinion driven by the steam-engine or other power, and communicating motion to the wheel C. B lever for engaging and disengaging the motion. D D D, axis of the wheels. E, pinion on the axis communicating motion to the wheel F. G G G, coupling box with pinching screws, for driving boring-bar. I I I, plummer-block for the axis D. J J, strongiron plate for fixing and holding down the shafts DG. K K K K, strong bolts for holding down plummer blocks I I. L L, strong mason-work. M M, level of floor upon which the rail-road is placed. N N N N, end view of rail-roads upon which the boring carriage to be described moves. O O O, end view of racks for advancing the carriage forward to the cutter-block. P P P, end view of walls or foundations to which rail-roads are fixed. Q Q Q Q, strong holding down bolts for rail-roads.

Fig. 2. Perspective view of boring carriage for small work. A, pump to be bored. C, Boring-bar. D, carriage advanced forward by the lever E and weight F, by means of the pinion G, working into the rack H. I I, rail-road. J J, carriage wheels moving on rail-road.

Fig. 3. Section of boring-bar for larger cylinders. A, coupling box. B, coupling shaft. C C C, standards for carrying boring-bar and framing for wheel work. D, hollow boring-bar turned on the outside to a complete cylinder, upon which the accuracy of the work entirely depends. E, cutter-wheel moved along the bar D by the screw F in the inside of the hollow bar. G, pinion on boring-bar working into the wheel H, giving motion to the shaft I, and pinion K, working into the wheel L, which gives motion to the screw F, for advancing forward the cutter-wheel E.

Fig. 4. End view of standard for supporting the bar.

Fig. 5. Cutter-block for hollow bar, Fig. 3; 1, sliding box which is accurately fitted on the hollow bar, and upon which the different sizes of cutter-blocks are keyed by the keys 2 2 2.

Fig. 6. Cutter-block for smaller work. 1 1 1, steel cutters. 2 2 2, wooden wedges for keeping the cutter-block steady.

The motion of the different shafts is best regulated by the alteration of the first moving power, A, Fig. 1. The wheel C with its shaft, Fig. 1. should move from two to three revolutions in the minute for small work, and the wheel F from a half-revolution to one revolution in a minute, for cylinders or larger work. The ingenious mechanic will readily perceive, that with a sufficient moving power the apparatus may be extended, and any number of borers may be employed at the same time. In some works the boring of six or more pieces of work is going on at once.

For the description and information relative to the above apparatus, we are indebted to Mr Gutzmer, the proprietor of the foundery, Leith Walk, Edinburgh, whose ingenuity and accuracy, in the construction aud fitting up of machinery, are deservedly acknowledged by all who have had the benefit of his talents.

BORMIO, a district in Switzerland, about 15 miles in length and the same in breadth, and forming part of the country inhabited by the Grisons, is surrounded almost on all sides by the lofty Rhetian Alps. It is in general extremely fertile; on the hills, besides extensive woods that adorn their majestic brows, the inhabitants rear numerous herds of cattle; and the valleys, if well cultivated, might produce abundant crops of grain. But agriculture is not the chief object of the inhabitants, as appears from the number

BORING-MACHINERY.

PLATE 27.

Fig.1.

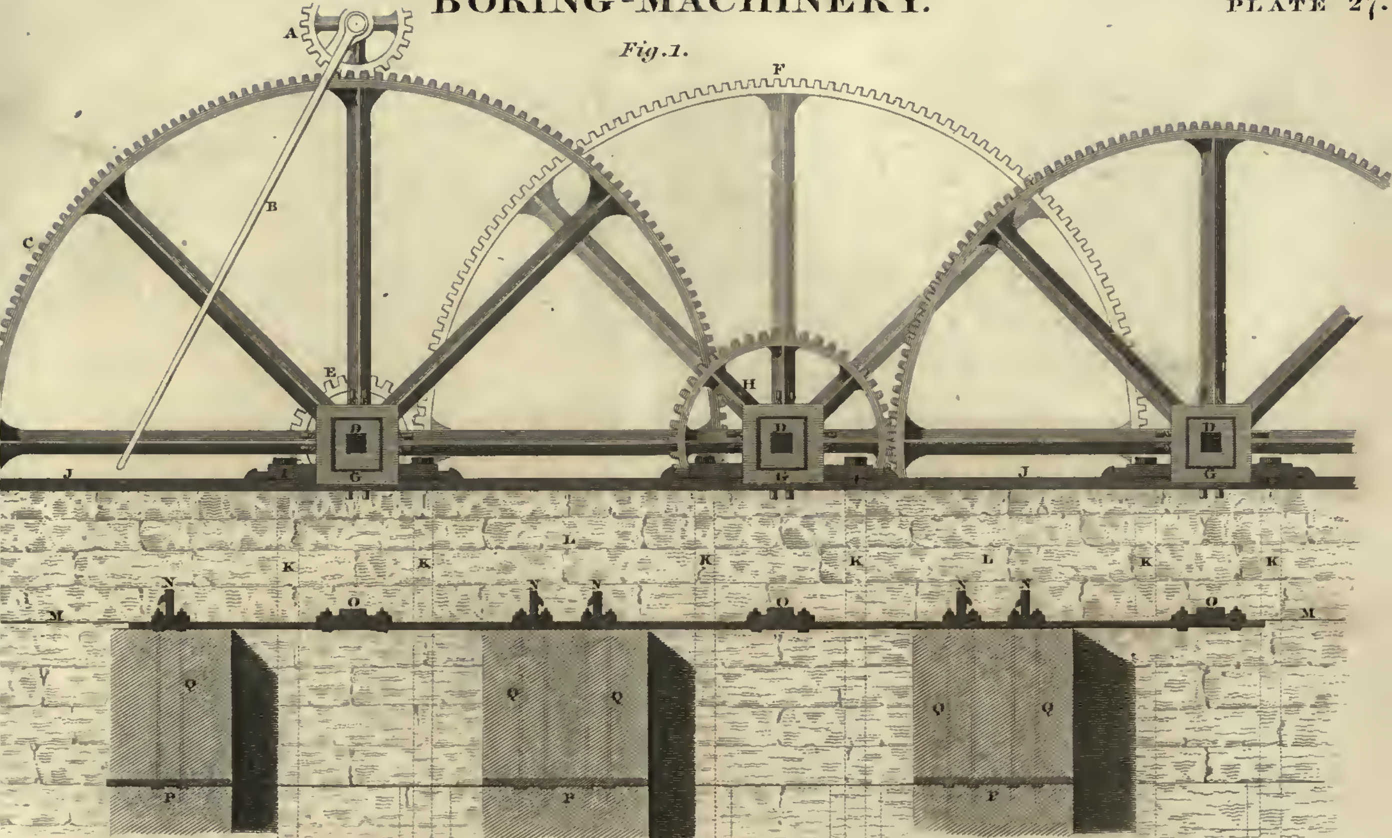


Fig.3.

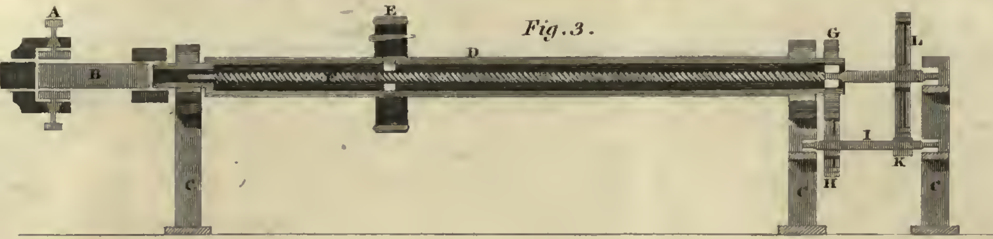


Fig.4.

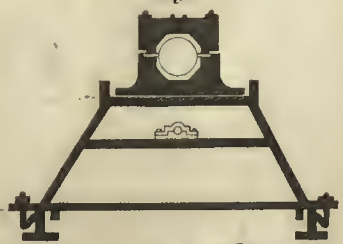


Fig.5.

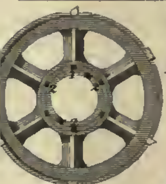


Fig.6.

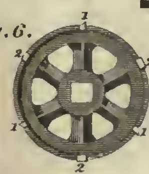
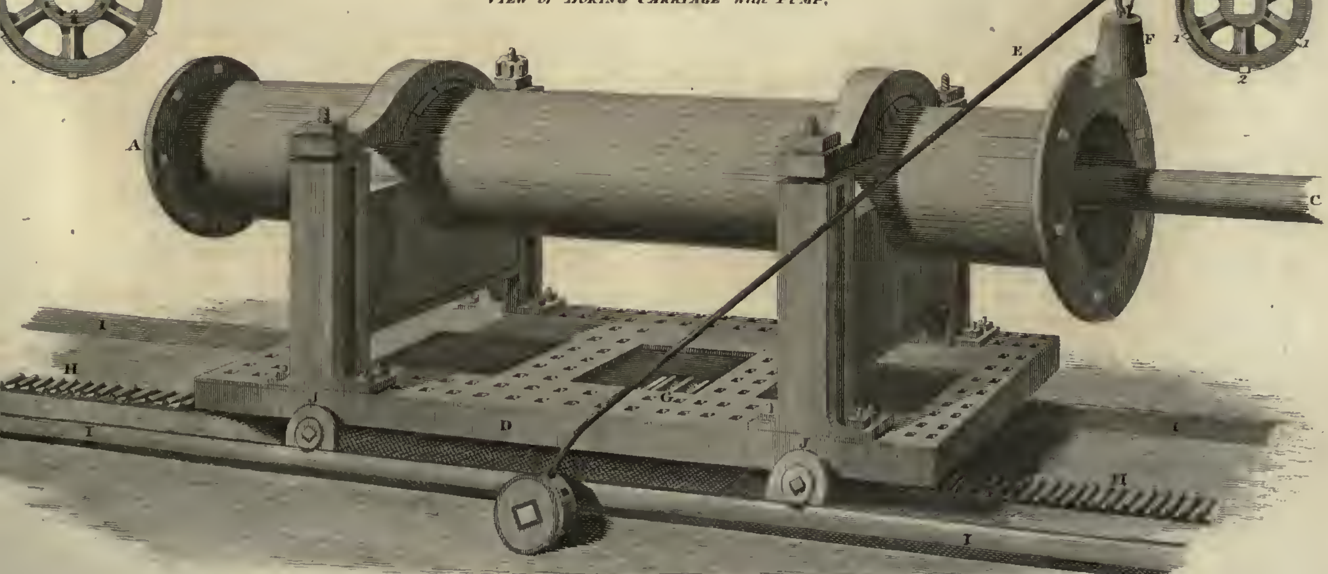


Fig.2.

VIEW of BORING CARRIAGE with PUMP.



Drawn & Engraved by W. & D. Lizars for the Encyclopædia Edinensis.

Born.

of exported cattle, and the quantity of imported corn; for although Bormio is nearly encompassed with high and rugged mountains, they trade with every country that surrounds their territory,—exchanging the produce of their hills, mines, and dairies, for the wine of the Valteline, the cloth of Germany, and the corn of Tyrol.

The climate of this district is keen, but pure and salubrious. The population is about 14,000; and the Grisons when called upon to defend their territory, or to maintain their rights and privileges, can bring into the field a formidable force.

BORMIO, the capital and principal town of the district of the same name in Switzerland, stands in a delightful situation between two rivers. The general aspect is extremely mean; and even the residences of those of superior rank, as well as the public buildings, display little taste either in beauty of architecture or internal convenience; yet some of them might be regarded as ornaments of the place, were they not disfigured by miserable huts in their vicinity. At a short distance from the town are the famous warm baths of St Martin's, greatly esteemed for their virtues in the cure of various diseases.

BORN, Inigo, better known by the name of Baron Born, an eminent German mineralogist, descended from a noble family in Transylvania, was born in 1742, was educated in the Jesuits college at Vienna, and after a tour through various parts of Germany, Holland, and France, he returned to Prague, commenced the study of natural history and mining, and in 1770 was admitted into the department of the mines and mint established in that city. In the same year he travelled through Transylvania and Hungary, and the detail of the information collected on this journey, chiefly relative to mineralogy and geology, was published in a series of letters addressed to the celebrated naturalist Ferber; a translation of this work from the German afterwards appeared in English. While on this journey he had nearly lost his life by descending into a mine at Felso-Banya, in which some wood had been burnt, the smoke of which was not dissipated. In the succeeding year he was appointed counsellor of the royal mines in Bohemia, and continued through life to devote a large portion of his time to mining operations, and to the improvement of the processes which are employed in separating the precious metals from their ores, and particularly of the process of amalgamation, on which he afterwards composed a treatise, which was also published in an English translation. Baron Born had a considerable share in the secret associations, under the name of free masons and illuminati, which prevailed in Germany during his time; and as he possessed talents for humour, he was not scrupulous in indulging his satirical powers against some of the institutions and monastic orders of the Romish church. Having suffered much through life from the accident which befel him in the mine of Felso-Banya, he died in the year 1791, leaving a wife and two daughters not only to lament his loss, but to feel the effects of the embarrassed state of his affairs, arising chiefly, it is supposed, from the expensive nature of the experiments in which he was concerned.

Baron Born was the author of several other works, particularly a catalogue of his own mineral collection, which he afterwards disposed of to the honourable Mr Greville, and which forms a part of that gentleman's splendid collection purchased by the public, and now deposited in the British Museum; the catalogue of Miss Raab's collection of minerals; and a superb work on conchology, descriptive of the shells in the imperial cabinet. To his praise it is recorded, that the learned stranger who visited Vienna never failed to experience his hospitality; and unprotected genius always found in him a warm friend and a liberal patron.

Borneo.

BORNEO, one of the Sunda islands, extends from the 8th degree of north latitude to the 4th degree of south latitude, and from the 109th to the 119th degree of east longitude; is in breadth about 800 miles, and in length about 700 miles, and, before the discovery of New Holland, was supposed to be the largest island in the world. Though situated beneath the equator, and exposed to the rays of a vertical sun, it enjoys a mild and salubrious climate, free from oppressive heat, and purified by gentle breezes and refreshing showers. It is extremely fertile in animal, mineral, and vegetable productions. Of the former, elephants, bears, tigers, buffaloes, orang-outangs, and a peculiar species of black and white ape, are abundant; and on the sea coast is found a sort of snail, which forms a valuable commodity in the trade to China. Among the mineral productions may be mentioned tin, iron, copper, gold, and diamonds, the last of which are likewise found in several rivers, are supposed to be of a finer water than those of Hindostan, and constitute a lucrative branch of commerce. The vegetable productions, as the various sorts of delicious fruits, vast quantities of pepper, and other spiceries, and, in the northern parts, the extensive forests of excellent kinds of timber for various purposes, give ample proof of a rich soil and genial climate.

The inland parts are mountainous, and inhabited by the Idaans and Biadjoos, a race of savages who boast in the number of victims that fall a sacrifice to their barbarity, and whose skulls they expose in public as trophies of their valour. In their marriage and funeral ceremonies the same inhuman custom is observed. In the former it is necessary that the suitor, before he can obtain the consent of the parents of his intended bride, produce the head of an enemy as a token of his courage; and in the rites of the latter a similar cruelty is practised, by the friends of the deceased putting to death a slave in order to attend his master in another state. These barbarians, though they have no sovereign of their own, in some degree show respect to the sultan of Banjar-massin, by giving annually a little gold-dust; yet they acknowledge the authority of a chieftain, whose power is confined within narrow limits. No regular code of laws or form of government exists; but when any trespass is committed to the prejudice of an individual, and no sufficient evidence is produced to convict the accused, a method is adopted, similar to the trial by ordeal, to ascertain his innocence or guilt.

The coasts of Borneo are inhabited by the Moors, a people more civilized in their manners, and contains seven provinces or kingdoms, the largest of which, Banjar-massin, is celebrated on account of various attempts by Europeans to form a junction with the natives for commercial purposes. The first was made by the Portuguese in 1526; in this attempt they failed; but about the close of the 17th century they were allowed to establish a factory, and by the treachery of the Moors the whole settlers were murdered, and their vessels and property seized. The Spaniards also visited the island, and were equally unsuccessful. The Dutch likewise endeavoured to plant a colony, but being at first disappointed, they appeared again on the coast of Borneo, and obtained permission to erect a factory at Banjar-massin, under certain regulations. The English, in their turn, attempted several times to form a settlement. Their first landing, in 1694, proved entirely fruitless; but when they arrived a second time, the natives appeared more friendly to their wishes, and, by the assistance of a number of Indians, a colony was begun, which had a promising appearance, yet, falling short of several necessaries of life, they were obliged to abandon it. The third time they landed on the island, to regain possession of their colony, the Moors attacked them, but were driven back; and the brave commandant, Captain Barr, dying in 1706, two years after the forming of the establishment, and the command having devolved on Cunningham, a weak and cowardly person, the colony was assaulted and given up, the governor with his whole garrison embarked for England without offering the least resistance, and the enemy plundered their stores, and destroyed the extensive works. And, in 1766, a settlement was formed in another quarter, which, after existing a few years, was entirely destroyed by the natives; yet in Borneo, the capital of the kingdom of that name, the English have still a factory, and retain possession of the northern coast of the island.

Before this portion of the globe was known to Europeans, the Chinese were in possession of the principal trade of Borneo, and a large share still remains in their hands. For various kinds of wood, tortoise-shell, spiceries, gums, camphor, and swallows nests, they exchange silks, chintz, calicoes, and the different manufactures of China and Japan.

BORNEO, a sea-port town of the island of Borneo, and capital of a kingdom of the same name, which occupies a marshy situation on the banks of the river Borneo, on the north-west quarter of the island; the houses are raised on piles of wood; the communication is by boats on the river, or canals; and a considerable trade is carried on between the natives and foreigners who frequent the harbour.

BORNHOLM, an island in the Baltic, subject to Denmark, is about six miles in length, and three miles in breadth, and is sixteen miles distant from Zealand. All kinds of grain are raised, and excellent pastures afford nourishment to sheep and cattle. The number of inhabitants is estimated at 30,000, and they are distributed into six small towns and numerous farm-houses in every part of the island. The fishing of herring, cod, and salmon gives employment to a large proportion of the population, and in the curing and smoking of salmon they are particularly successful.

BORNOU, an extensive region of Africa, which is included between the 22° and 27° of N. lat. and is bounded on the S. E. by Fezzan, and on the W. by Nubia. The heat is often excessive, and deluges of rain, and tempests of thunder and lightning, which are often highly destructive, are frequent. As in other districts of Africa, fertile spots and barren wastes cover the surface of Bornou. Indian corn is much cultivated; cotton, hemp, and indigo thrive well, and the rich fruits of tropical climates are abundant. Sheep, goats, cattle, buffaloes, horses, and camels are reared, and the lion, the leopard, the wolf, and the antelope, are enumerated among the wild animals. The houses are constructed in the same manner as in other regions of Africa, and the towns are composed of straggling houses.

The inhabitants of Bornou are of a black complexion, but have features somewhat different from those of the negro race. Some of them profess the religion of Mahomet, but the larger portion is addicted to pagan superstition. The government is a kind of monarchy, but the sovereign is elected from some one of the royal family, according to the choice of three persons of respectable character; this arbitrary mode of election is no doubt influenced by force and cunning, and is the fertile source, among a rude and turbulent people, of frequent revolutions and barbarous murders. Coarse linen and some cotton stuffs, a kind of carpets, and a coarse cloth of goats and camels hair mixed with wool, are manufactured in the country; and gold-dust, ostrich feathers, salt, some perfumes, horses, and slaves, are the chief commodities for their commercial intercourse with Tripoli.

Bornou, the capital of the empire, is a town of considerable extent, and is 600 miles S. E. from Mourzouk.

BOROUGH, or BURGH, from the Saxon borgh, usually denotes a town or corporation which has not the rank of a city, but is particularly applied to towns which possess the privilege of sending representatives to parliament. Borough is supposed by some to have originally meant a tything, or community of ten families, who were conjoined and bound together as pledges for the conduct of each other. The term borough afterwards was employed to denote a town which was fortified by means of a wall or some kind of enclosure, and, in latter times, country towns of any note, whether walled or not, had the same appellation. Cities were denominated boroughs by the ancient Saxons, but the episcopal sees being removed from villages and small towns, the name of city was limited to episcopal towns, and the denomination of borough was retained by all others. The boroughs of England are distinguished into those which enjoy their rights by statute or charter, and by prescription or custom, and some of them send one and others two representatives to parliament.

The boroughs of Scotland are either royal boroughs or boroughs of regality. The first are constituted by charter of the sovereign, and have the power of electing annually their own magistrates, whose authority extends to the regulation of all matters of police connected with the corporation, and, within a limited extent, to civil and criminal matters. The whole of the boroughs of Scotland return fifteen members to the British parliament; so that several boroughs, generally five, unite in the election of a member.

The convention of royal boroughs, which was constituted by James III. in 1487, and consists of deputies or commissioners from each of the royal boroughs, first met at Inverkeithing, and is now held annually at Edinburgh, for the purpose of considering and regulating all matters relative to trade and the general interests of the boroughs.

The right of electing magistrates in boroughs of barony and regality, is sometimes committed to the inhabitants themselves, and sometimes retained by the baron or superior; the powers of the magistrates of such boroughs are more limited than those of royal boroughs, and extend chiefly to the cognizance of debts, and questions of possession between the inhabitants.

BOROUGH ENGLISH is a peculiar descent of lands or tenements in some ancient boroughs and copyhold manors, by which the youngest son succeeds to the possession on the death of the father, the reason of which, as it is assigned by some, is the tender age of the youngest son, by which he is less able to provide for himself; but by others this custom is traced to the pastoral state of society, such as exists among the Tartars at the present day, among whom the elder sons are allowed a certain portion of cattle, and seek a new habitation, while the youngest son remains longest with the father, and becomes the heir of his possessions. This custom also prevails among some northern nations, and is alluded to by Cæsar and Tacitus.

BOROUGH-HEAD, or HEAD-BOROUGH, or Tything-man, was the chief man of a tything or hundred, and was chosen annually, according to the institutions of Alfred, to preside over its affairs; but the appellation Head-borough is now applied to a kind of head constable.

BORROWSTOWNNESS, sometimes called BO'NESS, a town of Linlithgowshire in Scotland, stands on a point of land on the south side of the frith of Forth, and is 18 miles N.W. from Edinburgh; the streets in general have no great regularity, but contain some good houses, besides extensive warehouses for grain and merchandise. It became a place of some importance about the beginning of the 18th century. The population stated at 2613 in 1794, had only increased to 2919 in 1811; but the trade, both foreign and coastwise, which was at one time considerable, had greatly declined. The manufacture of salt, which has been long extensively conducted, of sal ammoniac, soap, and of earthen and stone-ware, derive great facilities from the abundance of coal in the neighbourhood. Some ship-building is also carried on; and many of the women in the town and vicinity are occupied in tambouring, and in the spinning of silk for stockings.

BOSCOVICH, ROGER JOSEPH, an eminent mathematician, and the founder of a theory of natural philosophy, was born at Ragusa in Dalmatia on the 11th May 1711. His earlier years were spent at the schools of the Jesuits in his native place, and gave promise of the eminence and reputation to which he afterwards attained. He was removed to Rome in 1725, according to the policy of the Jesuits which enjoined the supreme care and education of those pupils who exhibited the greatest talents and most effective improvement. Here he took the habit of the noviciate, cultivated theology and general science, perfected himself in classical studies, and from the station of private teacher was at last promoted to the professorship of mathematics; for which department of knowledge, notwithstanding the variety of objects presented to his ambitious and enterprising mind, he continued to display the strongest genius and predilection. In the discharge of the duties of his office, he composed several elementary treatises on different branches of the science, some of which have very uncommon merit. He had the rare and valuable art of combining strictness of reasoning on profound subjects with the rich and varied product of a lively fancy, and those embellishments of taste and manner which never fail to captivate attention. A considerable talent for the composition of poetry furnished him with topics and illustrations, and a facility in reciting verses yielded gracefulness and the most imposing effect to his stated labours and ordinary conversation. These and other excellencies soon raised him to the highest distinction and secured general applause, whilst the extent of his learning, the depth and solidity of his judgment, the acuteness and inventive power of his genius, added to the integrity and amiableness of his character, formed the substantial means of supporting and enhancing any reputation which he acquired.

The fame of Boscovich, accordingly, in a short time, travelled much beyond the circle of his acquaintance, or even his extensive official responsibility. Foreign societies appear to have vied in the abundance of honours which they conferred on him; and his advice and assistance were thought worthy of being solicitously applied for in order to determine the disputes of various princes and states. An engagement of this kind, in behalf of his native country, brought him to London, where he was favourably received, and where he had the satisfaction of obtaining a title, certainly not less flattering than any that had hitherto graced his name, that of a Fellow of the Royal Society. During his residence in this city, he published his work *De Solis ac Lunæ Defectibus*, and dedicated it to the body of which he was thus chosen a member. It is one of the few examples of didactic poems, in which the principles of science are happily blended with the offspring of creative imagination, and the beauties of language. Boscovich accomplished the object of his mission, and prepared to return home, but not before receiving another proof of the respect in which he was held. This was an invitation by the Royal Society to accompany some of its members destined for America, to observe the approaching transit of Venus, which, for various reasons, he found it necessary to decline.

Accompanying a friend whom he met at Venice, he visited the plain of Troy, and afterwards resided a short time at Constantinople, and having traversed Bulgaria, Moldavia, and part of Poland, projected a journey to Petersburg, but abandoned his intention on hearing of the death of the Emperor Peter. Some time after his return to Rome, Boscovich was appointed to the professorship of mathematics in the university of Pavia, which was soon relinquished for the chair of astronomy and optics at Milan, under the patronage of the Empress, and with the superintendence of the observatory at Brera. The envy or contemptible jealousy of some of his contemporaries and colleagues, had ere now invaded the philosophical retirement and indulgence which he had promised himself in the evening of his days; and he had already experienced an attack on his health which threatened his dissolution, and from which it is doubtful if he ever thoroughly recovered.

The suppression of the order of the Jesuits, which took place in 1773, augmented his distress, and prevented the plan he had formed of retiring for the remainder of his days to his native city, in hopes of enjoying that tranquillity and affection which seemed so necessary to his existence. He finally determined, in his embarrassments of mind, body, and estate, to retire to Paris, where he had, when once on a visit, been so hospitably entertained, and where it was supposed the respectability of his character, and the amount of his services to science, could not fail to procure an adequate establishment and comfort. The munificence of the French monarch, through the interest of the chamberlain La Bord, one of his friends, so far realized these hopes, as to appoint him director of optics for the marine, with a salary of more than L.300 sterling,—a sum fully commensurate to his moderate habits. But this liberality could hardly soften down some strong prejudices which he manifested against the manners and principles of his new associates, and the French in general, and far less could obviate a very visible inclination on the part of many to detract from his merits, or to suggest that they had been too amply rewarded.

The keen feelings of the Ragusan, and a conscientious regard to religion, bitterly contended with his sense of duty and a conviction of necessity, for about ten years, when he solicited and obtained leave of absence to visit his friends in Italy. At Bassano, in the state of Venice, which was the first place where he now resided for any considerable period, he published a collection of some of his works, in five vols. 4to, and in the Latin, Italian, and French languages. This abounds in curious, profound, and valuable dissertations on mathematical and philosophical subjects. He afterwards travelled to Rome, in order to see some of his early acquaintances, and thence to Milan, where the resumption of his studies, and the felicity of a respected and respecting society, shed a ray of pleasure on the shortening period for which his leave of absence had been granted. But in proportion to its intensity was his apprehension of misery as the effect of fulfilling his obligations to royal favour. His mind, long harrassed by dread of encountering a renewal, perhaps an aggravation, of the jealousies and discordancies which had formerly assailed him, urged on by solicitude at the same time not to appear wanting in gratitude, and, in all probability impaired in the natural course of bodily infirmity and advancing age, at last sunk in the conflict. A state of derangement ensued, not, however, without some lucid moments, which at one time gave room to anticipate comparative restoration. A relapse followed, and an imposthume bursting in his breast, he was released from suffering on the 13th of February 1787, in the 76th year of his age. "Such was the exit," says one of his biographers, Fabroni, "of this sublime genius, whom Rome honoured as her master, whom all Italy regarded as her ornament, and to whom Greece would have erected a statue, had she, for want of space, been obliged even to throw down some of her heroes."

Boscovich was tall and robust; his complexion was sallow; his temper was somewhat irritable; and a degree of vanity was conspicuous in his usual deportment, and still more in his frequent allusions to his own works; but it was compensated by liveliness of wit, elegance and fluency of conversation, and the more estimable qualities of cordial friendship and benevolence of disposition.

Of the works of Boscovich, which are too numerous to be specified, Dr Hutton's classification may suffice. 1. Elements of Mathematics, with a Treatise on Conic Sections. 2. His many Dissertations published during his professorship in the Roman college. 3. His account of the Survey of the Pope's Estate. 4. His Poem on Solar and Lunar Eclipses, already mentioned. 5. The five volumes published at Bassano. 6. His Hydrodynamical works. 7. A Theory of Natural Philosophy. This last work is said to have been composed in thirty days. It was first printed at Vienna in 1758; and a second edition, *ab auctore perpolita et aucta*, appeared at Venice in 1763, a presentation copy of which to an illustrious character in our own country is now in the hands of the writer.

BOSJESMANS, or BOSHIESMEN, a tribe of Hottentots who occupy an extensive district at the Cape of Good Hope; they derive this name, which is equivalent to Bushmen, from having their abodes in woody and mountainous places. They are described as a rude and barbarous people, of small stature, and are said to be the ugliest of all the savage tribes; they have scarcely any covering to their bodies, and their precarious subsistence chiefly depends on plunder, or on locusts, and the spontaneous productions of the soil. The arms which they employ in their predatory excursions are bows and arrows, and lances, and it is said that they use poisoned weapons. These savages have often been extremely troublesome to the Dutch colonists, by whom they are treated with great barbarity, and hunted like wild beasts. According to the relation of Mr Barrow, one colonist boasted of having shot not fewer than 300 of that unfortunate tribe with his own hand. Those who are taken prisoners are doomed to slavery the rest of their lives.—*Barrow's Travels in Southern Africa.*

BOSNIA, a mountainous province of European Turkey, so called from the river of that name which passes through it and falls into the Save, is bounded on the N. by Sclavonia, on the east by Servia, on the S. by Servia and Albania, and on the W. by Dalmatia and Croatia, and is about 120 miles in length, and 72 in breadth. The soil is fertile, particularly near the rivers, producing good wheat; numerous herds of cattle are reared on its excellent pastures; and it is also enriched with silver mines. Bosnia exports to Sclavonia, raw skins, wool, and cotton, but not to any extent, and at other small ports the Bosnians exchange their cattle, where weekly fairs are held, under the cognizance of a customhouse-officer.

This province was anciently part of Pannonia, but became, in course of time, part of Hungary, was erected into a kingdom, and governed by its own kings till 1465, when the Turks became its masters. The inhabitants are Greek Christians, with some Mahometans, Jews, and Catholics. The capital of the province is Banjaluka.

BOSPHORUS, from two Greek words signifying the passage of oxen, is chiefly applied to the straits of Constantinople, or the Thracian Bosphorus, and to the straits of Caffa, or the Cimmerian or Scythian Bosphorus, which joins the sea of Azof with the Black sea. The narrowness of these straits, which permitted an ox easily to swim across, according to one opinion, gave origin to the name; but, according to another, it was derived from a market for cattle being held in its vicinity. The Thracian Bosphorus is about twenty miles in length, and two miles in breadth; the breadth of the Cimmerian Bosphorus is stated at twelve miles.

BOSSUET, James Benigne, an eminent French divine, and eloquent preacher, was born at Dijon in 1627, commenced his studies among the Jesuits, and completed his education at Paris. He was early destined to the clerical profession; and by the study of the sacred writings, the ancient fathers of the church, and the classical productions of Greece and Rome, he soon distinguished himself by varied acquirements and extensive learning. At the age of sixteen he displayed remarkable powers for eloquence, and became one of the first preachers in France. The reputation of his splendid talents reached the court, where he obtained the favour of Louis XIV. was promoted to a bishopric, and afterwards intrusted with the charge of the dauphin's education. For the use of his royal pupil his *Discourse on Universal History* was composed, one of the most valuable of his works, which is still read with advantage, and admired as a comprehensive sketch of the subject. When he entered on the duty of superintending the studies of the heir of the throne of France, Bossuet had resigned his bishopric; and when he had finished this task, his fidelity and diligence were rewarded by his promotion to the see of Meaux. In this dignified station he devoted himself with great assiduity to the service of religion, and was not less zealous in defence of the catholic faith. This led him into numerous and violent theological controversies, in which he displayed great acuteness and vigorous powers of argumentation. But in the midst of these disputes the harshness and severity with which he opposed the views and doctrines of the amiable and celebrated Fenelon, a member of the same church with himself, have been justly censured and generally regretted; and although the piety and zeal of the bishop of Meaux have been rarely called in question, or ascribed to any other motive than sincerity of conviction, yet his conduct in this case seems not altogether divested of invidious feeling.

Retiring from the splendour and bustle of a court, Bossuet devoted the last years of his life to the useful and unobtrusive duties of a Christian minister; and the same person who had acquired such distinguished reputation on the great theatre of the world, was equally assiduous in dispelling the darkness of ignorance by the light of truth, in pouring the balm of consolation into the wounded mind, and in providing for the temporal wants of the indigent and unfortunate among the meanest of his flock; In the midst of these humble and important services, he closed his mortal career in the year 1704. The sermons of the bishop of Meaux, which have been printed, are less to be regarded as finished compositions than rapid sketches; but they exhibit ample proofs of powerful genius; and his funeral orations, which are distinguished by elevated sentiments and tender effusions, are universally admitted as unrivalled productions.

BOSTON, a town of Lincolnshire, in England, stands on the banks of the river Witham, about five miles distant from the sea; the town is well built, and has been greatly improved of late years; a spacious market-place is adorned with a fine cross; and St Botolph's church, the building of which commenced in the beginning of the 14th century, is a magnificent structure, and the largest parochial church, without cross-aisles, in Europe. Its lofty tower, which rises to the height of 282 feet, serves as a landmark to mariners. The correspondence of the pillars, windows, and steps in this church and tower, to the months, weeks, and days of the year, is somewhat singular. The population, in 1811, exceeded 8000, and the inhabitants are employed both in foreign and coasting trade. The river is navigable for small vessels to the town.

BOSTON, the capital of Massachussets and of New England, in North America, occupies a peninsular situation at the bottom of Massachussets' bay. The town is disposed in a crescent form round the harbour, and the country rises gradually behind it, presenting, to those who approach it from sea, a singularly beautiful and picturesque scene. Boston is indebted for its origin to a colony from Charlestown in 1631; in 1727 it sustained great damage from an earthquake; and, since that time, as the houses are chiefly of wood, has repeatedly suffered from destructive fires. Many of the public buildings are magnificent structures, and two bridges over Charles' river are not less ornamental to the place than commodious for the inhabitants; the harbour is spacious and convenient, and capable of admitting 500 sail to ride at anchor; and the narrow entrance is defended by a fort, erected on an island, and well furnished with heavy artillery.

The population of Boston, which was estimated, in 1790, at 18,000, exceeded 20,000 in the year 1800. Sail-cloth, cordage, sugar-refining, hats, glass, tobacco, paper hangings, cards for wool and cotton, and playing cards, are the principal manufactures; the trade, foreign and coastwise, is considerable; and charitable institutions, as well as those for promoting the improvement of arts and literature, are numerous.

BOSWELL, James, the celebrated biographer of Dr Johnson, was the son of Alexander Boswell, the representative of an ancient family in Ayrshire, and a judge of the supreme civil and criminal courts of Scotland, who, on his elevation to the Bench, in compliance with the custom of the

Boswell. country, assumed the distinctive title of Lord Auchinleck, the name of his patrimonial estate. James, the subject of this notice, was born in Edinburgh, October 1740. His education, for which, from the beginning, he discovered a high degree of aptitude, commenced in his father's house, and was successfully prosecuted at the school of Mr Mundell in Edinburgh, and afterwards at the universities both of that city and of Glasgow. In the twentieth year of his age he visited London, and happening to form an intimacy with Mr Derrick, a man of literary pursuits, and well known in the city, he was by him introduced to its novelties and gaieties, in all their variety. At this time, swayed by inclination, and in love with a London life, he wished to obtain a commission in the guards, but his father having signified his disapprobation, he relinquished the design, returned to Edinburgh, and resumed the study of the law.

In 1763, when in London, on his way to the continent, he was first introduced to Dr Johnson, with whom he afterwards spent so much of his time, and with whose name his own has been since so closely associated. On his arrival on the continent he made some stay in Holland and Flanders; he traversed a considerable part of Germany; passed through Switzerland to Geneva; over the Alps to Italy, and thence to Corsica; he returned home in 1766, and commenced his career as a counsellor at the Scotch bar. The Douglas cause, then pending, having excited a general interest, he drew up and published a popular view of the respective claims of both the parties, which he entitled, *The Essence of the Douglas cause.* In 1768, he published *his Account of Corsica, and his Memoirs of General Paoli,* a work which was highly commended by Johnson, and very acceptable to the public. In the following year his happiness was enhanced by his marriage with Miss Margaret Montgomery, his own cousin. From this time he passed a series of years amid the comforts of domestic and social life. He lived in terms of the closest intimacy with the most eminent characters of the age both for rank and literature, among whom were Lords Kames and Hailes, Drs Robertson and Blair. In 1773, he and Johnson made their long projected tour to the Hebrides, a journey which has been rendered memorable by means of the lively and characteristic accounts which both have published of it.

From the period in which Boswell had read the Spectator he had felt and cherished a strong predilection for the manners of England, and this feeling was strengthened by the friendships which he formed with some of the gentlemen from the southern part of the island, whom he met while a student at Glasgow college, as well as in his frequent visits to the metropolis; and having lately succeeded to his father's fortune, which was sufficiently ample to warrant his design, he resolved to gratify his inclination by settling finally in London, a scheme which he carried into effect in the year 1786. The remainder of his life was spent chiefly in London, where he died of a lingering illness on the 19th of June 1795. Dr Johnson paid the debt of nature in December 1784, and Boswell's account of his life appeared in two thick quarto volumes in 1790. It is presumed that there are few English readers who have not perused and have been pleased and instructed with this work. The constant obtrusion of the author and his affairs—all that he was, or is, or would be—on the reader's attention, though at first provoking to disgust or contempt, soon becomes highly amusing, and constitutes a principal part of the entertainment. The numerous anecdotes of persons and events which it contains, serves in many instances to illustrate the literary history of the period it includes. The preservation of so many of the opinions and sentiments of Johnson in his own language, both on subjects with which his studies had made him familiar, as well as on those to which it was not suspected he had bestowed any portion of his attention, displays the strength and the extent of his powers, and forms at the same time a valuable repository of critical, moral, and political maxims and rules. And still more, the dramatic form in which so large a portion of it is cast, and so well sustained, gives an impressive reality to the scenes which it exhibits,—presents a finished picture of the domestic manners of the age to which it belongs,—and affords an exquisite gratification to that gossiping curiosity which seems inherent in human nature.

Thus, though Boswell's life of Johnson cannot be recommended as a model of biographical composition, and never can be generally imitated; because the suspicion of a person haunting social scenes, watching and writing down with the view of publishing whatever is said or done in the most unguarded moments of life, would soon destroy *the play of fancy and the flow of soul,* and introduce into conversation, study, and stiffness, and hypocrisy; and because few will be found inclined, or qualified to undertake the task of following, and observing, and recording the ordinary discourse and private behaviour of any man, in order to enable them to detail the particulars of his conduct, and to delineate the features of his character; yet, as often as a Johnson appears on the stage of life, it is devoutly to be wished, that, with this intention, he may be attended by a patient, a persevering, and an admiring Boswell.

BOTANY.

Introduction.

Introduction.

Botany, from a Greek word, which signifies *herb*, or *grass*, is that department of natural history by which plants are distinguished from each other and systematically arranged; but, in a more enlarged sense, it includes also a knowledge of the structure and functions of vegetables, as well as of their properties and uses.

The vegetable kingdom, which consists of more than 30,000 species, is divided, according to the system of Linnæus, into 24 classes; each class is subdivided into orders, and each order is again subdivided into genera and species. The classification of Linnæus is confessedly artificial; but it is by far the simplest and most convenient yet proposed for studying botany; and those who have made objections to this system, have forgotten, that its object is to distinguish plants from each other with precision, rather than to associate them according to their natural alliances. In all attempts to arrange and classify the objects of nature, it ought to be recollected, that it is for the purpose of assisting the limited powers of man in his investigations; and the more numerous any class of objects becomes, the more necessary it is to adopt method and arrangement in acquiring the knowledge of their distinctive properties. The books of a library, composed of many thousands of volumes on different subjects and in different languages, could not be easily found out if they were promiscuously placed in the shelves; but if they are arranged according to certain rules or principles, such as the subjects on which they treat, the language in which they are written, or even the form or size, the place in which they are deposited can be easily discovered. The amount of a sum of money, consisting of different kinds of coin, as copper, silver, and gold, thrown together into a heap, may be known by reckoning the number and value of each individual piece as it comes to hand; but the knowledge of the value of the whole will be more easily obtained, by arranging the different pieces according to the kind and value of each. All this, it must be admitted, is an artificial procedure; but it is quite obvious that it greatly abridges labour and facilitates investigation.

The characters of the classes in the Linnæan system are taken from certain parts within the flower. In the common primrose, or single polyanthus, the yellow part in the one, and the red in the other, is called the *corolla;* and the green part, which is a continuation of the covering of the stem, is called the cup, or *calyx*, from its shape. Separate the corolla from the calyx, and open the tube of the corolla with a pointed knife, and several threads or filaments attached to its inner surface, and supporting roundish bodies of a yellowish colour, will appear; these are called *stamina*, or *stamens*. Some of the classes are determined by the number of stamens; in this flower the number is five, denoting that it belongs to the fifth class. The flower of the crocus, examined in the same way, presents three stamens, shewing that it is arranged in the third class. Six stamens appear within the flower of the tulip, from which it takes its place in the sixth class; to which also belong the white and orange-lily, the snowdrop, and hyacinth. In the common pink are ten stamens, which point out its place in the tenth class.

Linnæan Classification.

The stamens in some of the flowers now mentioned, derive their origin from the inner surface of the flower, and when the flower is drawn out of the cup they come along with it; but when the six petals of the tulip are broken off, the stamens remain behind; and when these stamens are carefully removed, another part rising from the middle of the seed-vessel appears. This is called style or pistil; and from the number of pistils the orders are determined; as the tulip, in which there is one pistil, belongs to the first order. In the pink there are two pistils, and it belongs to the second order of its class. The characters of the genus are usually derived from the other parts of the flower, and those of the species are taken either from some peculiarity in the parts of fructification, or from the leaves, stem, or root. But, to be able to discriminate plants with facility and accuracy, it is necessary that the student of botany be familiar with the language which is employed, and be well acquainted with those parts on which the character of the classes, and their subordinate divisions, depend.

Chap. I. Principles of the Linnæan Classification.

The characters of the classes and orders of the Linnæan system are taken from the parts of fructification; those of the genera from the same parts, and those of the species from the leaves, stems, and roots.

Sect. I. *Parts of Fructification.*

The parts of fructification, as they are described by Linnæus, are seven in number; and as some of these parts are wanting in some plants, they are not all essentially necessary to the perfection of the seed or fruit. The seven parts are, the calyx or cup, the corolla or flower, the stamina or stamens, the pistillum or pistil, the pericarpium or seed-vessel, the seed, and the receptaculum or receptacle.

Linnæan Classification.

Calyx.—Several varieties of calyx are described; it is called perianthium, or perianth, when it includes the other parts of the flower, as in the primrose and the pink; but it is sometimes wanting, as in the tulip, in some cases permanent till the fruit is ripe, and in others it drops off before the flower is expanded; in mallow it is double, and in scabious it is triple. The *involucrum* is a kind of calyx peculiar to umbelliferous plants; and it is either partial or general, as it includes the whole or only a part of the umbel. The amentum or catkin is a common receptacle, furnished with scales, each of which includes the parts of fructification, and the whole forms an aggregate flower. The willow and the fir tribes furnish examples of the catkin. The *spatha*, or sheath, is a kind of calyx which appears in the snowdrop and the narcissus. The *gluma* or *glume* is the calyx peculiar to grasses, and it is of a chaffy texture.

Corolla.—The corolla is included within the calyx, and usually exhibits those rich and beautiful colours which are so much admired in plants. When the corolla consists of different parts, they are called petals; it consists sometimes of one petal, and then it is said to be monopetalous, as in the primrose; and when it consists of many petals, it is called polypetalous, as in the rose.

A monopetalous corolla is divided into two parts; the tube, or cylindrical part, included in the calyx, and the limb, *limbus*, which is spread out, as in the primrose. When the corolla consists of many petals, as in the pink, that part of it which appears without the calyx is called the border, or *lamina*, and that part inclosed in the calyx is denominated *unguis*, or claw. The corolla is said to be regular or irregular, equal or unequal, when its figure is uniform or otherwise, and the parts of which it is composed are of the same or of a different size.

The more common forms of a monopetalous corolla are the following: Bell-shaped, *campanulata*, as in campanula and hyacinth; funnel-shaped, *infundibuliformis*, as in pulmonaria or lungwort; salver-shaped *hypocrateriformis*, as in the primrose; wheel-shaped, *rotata*, which is the same as salver-shaped, but with scarcely any tube, as in borage; ringent, *ringens*, irregular and gaping, formerly called labiated or lipped, as in dead-nettle; and personate, *personata*, irregular, and closed by a kind of palate, as in snapdragon.

The polypetalous corolla is called cruciform, *cruciformis*, when the petals are disposed in the form of a cross, as in wallflower; rosaceous, *rosacea*, when the petals are disposed like a rose; papilionaceous, *papilionacea*, when they are irregular and spreading, and have the appearance of a butterfly.

The corolla is said to be incomplete when some parts seem wanting; and in some cases it is altogether wanting, although a diversity of opinion prevails whether the calyx, which is present in some of these cases, should not be considered as such.

Nectary.—The nectary, *nectarium*, is generally connected with the corolla, or forms part of it; the nectary is distinct from the petals of the corolla in columbine, and it is an elongation of the corolla in the violet, and a production of the calyx in Indian cress. Larkspur and monkshood furnish striking examples of the nectary in the spur-like appendages of their flowers; and a small gland at the base of the petals of some flowers, as the ranunculus, comes under the same denomination. The use assigned to the nectary is the secretion of honey.

Stamens.—The stamens are placed within the corolla, and vary in number in different flowers. A stamen consists of two parts, the filament and anther. In the pink the filament is slender, and in the orange-lily and tulip it is strong and thick; in some plants it is wanting; but where the filament exists it supports the anther, which is a membranous body, consisting generally of two cells or cavities. The pollen, or fine powder, is prepared in the anther, which either bursts longitudinally or opens by pores near the summit. The pollen, when examined with the microscope, exhibits great variety of form and structure in different plants.

Pistil.—The pistil is that part which arises from the centre of the flower; it is composed of three parts, the stigma, the style, and the germen. The stigma, which is the upper part of the pistil, is various in form, either simple, scarcely more than a point, globular, lobed, hollow, and gaping. The length and thickness of the style are various, but it is sometimes entirely wanting. The germen, which gives origin to the style and stigma, is also various in its form and size; sometimes it is included between the calyx and corolla, and then it is said to be superior, as in the strawberry and raspberry, and inferior, as in the apple and pear.

Pericarp.—The pericarp, *pericarpium*, or seed-vessel, is the enlarged germen or covering of the seed. It is not an essential part of every plant, for in some it is wanting, as in the dead-nettle, in which the seeds are naked in the bottom of the calyx; and in the common dandelion, and many plants of the same kind, the seeds are attached to the receptacle without any covering.

Various kinds of seed-vessels are described, as the capsule, which is of a leathery or membranous texture, composed of one or several cells, as in campanula and poppy. The follicle is a seed-vessel of one valve and one cell, bursting lengthwise, and bearing the seeds near its edges, as in periwinkle and pæony. The silique, *siliqua*, is a long dry seed-vessel of two valves, as in stock jilly-flower. The silicle is a short round pod, as in vernal whitlow grass. The legume, *legumen*, is a seed-vessel of two oblong valves, and is peculiar to the pea tribe. The tamarind produces a legume filled with pulp, in which the seeds are imbedded. The drupe, *drupa*, is the seed-vessel peculiar to stone fruit, has a fleshy coat, and contains a single hard and bony nut, as in the cherry, the plum, and the peach. The cocoa-nut also comes under the denomination of drupe. The pomum or apple has a fleshy coat, but includes a capsule, with several seeds, as in the common apple or pear. The berry, *bacca*, is fleshy, without valves, and contains one or more seeds, surrounded with pulp, as in deadly nightshade and ivy. The fruit of the raspberry and bramble is called a compound berry, and the separated parts are named *acini*. Strobilus or cone, is a catkin, hardened and enlarged into a seed-vessel, examples of which are found in the pine tribe.

The seeds are extremely various in form and size; they are composed of the embryo or germ; of cotyledons or seed-lobes; the *albumen* or farinaceous part; the *vitellus* or yoke; the testa, which contains the different parts of the seed; and the *hilum*, or scar, by which the seed is attached to the seed-vessel. The pellicle, or epidermis, adheres closely to the outside of some seeds; and the arillus, or tunic, is either a complete or partial covering attached to the base only, and surrounding the other parts more or less loosely. Some seeds are furnished with a pappus or down, which is chaffy, feathery, or bristly. The seeds of dandelion afford an example of the feathery structure. Seeds are also furnished with a tail, with a beak, or with wings.

The receptacle, *receptaculum*, is the common point of connection of all the other parts of fructification. It is called the receptacle of the flower, when the calyx, corolla, and stamens, only are attached to it. It is denominated a *proper* receptacle, when only one flower with its fruit is inserted into it,—and *common*, when it supports many flowers. In such as are called compound, it is very distinct, as in the daisy, where it is of a conical form; in others, it is convex, flat, or concave; and in some it is naked, hairy, scaly, or cellular, like a honey-comb.

Sect. II. *Of the Classes and Orders.*

The Linnæan system of botany includes 24 classes, the characters of which are derived from the number, situation, and proportion of the stamens. The first eleven classes are determined by the number of the stamens, and the names by which they are distinguished, derived from the Greek language, are characteristic of this mode of discrimination.

The 1st class, *Monandria*, signifies that the plants included under it have only one stamen. The 2d, class, *Diandria*, indicates two stamens; the 3d, *Triandria*, three stamens; 4th, *Tetrandria*, four stamens; 5th, *Pentandria*, five stamens; 6th, *Hexandria*, six stamens; 7th, *Heptandria*, seven stamens; 8th, *Octandria*, eight stamens; 9th, *Enneandria*, nine stamens; 10th, *Decandria*, ten stamens; 11th, *Dodecandria*, from 12 to 19 stamens; 12th, *Icosandria*, 20 or more stamens; and, 13th, *Polyandria*, in which the stamens are very numerous. But, in the two last classes, the situation of the stamens must be taken into consideration. When they arise from the inside of the calyx of plants they belong to the class Icosandria, as in the strawberry and bramble, the cherry and the myrtle; but when they are inserted into the receptacle or base of the flower, they fall under the class Polyandria, of which the poppy and anemone are good examples.

The 14th class, *Didynamia*, is distinguished by the proportion in the length of the stamens, which are four in number, two of which are long and two short. This is justly reckoned a natural class, for it includes plants which exhibit the same general character in the structure of their flowers, to which the denomination ringent or personate has been applied. The dead-nettle, foxglove, and snapdragon are examples.

The 15th class, *Tetradynamia*, is also a natural class, and is distinguished by four long and two short stamens; the flowers of this class are called cruciform, because the four petals of the corolla are set in opposition to each other in the form of a cross, as wallflower, radish, and mustard.

In the 16th class, *Monadelphia*, the stamens are united by their filaments into a tube, as is distinctly seen in mallow and lavatera, and less obvious in the numerous family of geranium.

The 17th class, *Diadelphia*, has the stamens united by their filaments in two parcels; and it is a natural class, for it consists of papilionaceous flowers, of which the flowers of the pea tribe are examples.

The 18th class, *Polyadelphia*, includes such plants as have the stamens united by the filaments into more than two parcels, as in St Johnswort.

In the 19th class, *Syngenesia*, the stamens are united by their anthers into a tube, and the flowers of this class are compound, that is, a number of flowers is collected together within the same calyx, or upon the same receptacle, of which the common daisy, dandelion, and sun-flower furnish appropriate examples.

The 20th class, *Gynandria*, is characterised by the stamens growing out of the pistil, or being united with it, of which examples are found in the orchis tribe.

The 21st class, *Monœcia*, signifying one house, includes those plants which have stamens and pistils in separate flowers, but growing on the same plant, as in the oak and hazel.

In the 22d class, *Diœcia*, which signifies two houses, the stamens and pistils are not only in separate flowers, but the flowers which produce stamens, and those which produce pistils, grow on separate plants, as in the hop, the willow, and yew.

The 23d class, *Polygamia*, comprehends such plants as have stamens and pistils separate in some flowers and united in others, either on the same plant or on two or three different plants, as in pellitory, and sea-purslane.

The 24th class, *Cryptogamia*, includes those plants in which the parts of fructification are not distinctly ascertained, and therefore cannot be referred to any of the preceding classes Ferns, mosses, and sea-weeds are examples of this class.

The *Palmæ*, palm-trees, from their peculiarity of structure and appearance, were described by Linnæus in an appendix to the twenty-four classes; but it appears, from the researches and observations of succeeding botanists, that they may be arranged under the Hexandria, or 6th class, or under Monœcia, or Diœcia, the 21st or 22d class.

Orders.—In the first 12 classes of the Linnæan system, the orders are determined by the number of pistils, and the Greek words, *Monogynia*, *Digynia*, *Trigynia*, denote one, two, or three pistils. The number of pistils is reckoned by the styles, or, when the style is wanting, by the number of stigmas, as in the gelder-rose; and the number of pistils expressed by the Greek numerals marks the order, as *Monogynia*, having one pistil, denotes the first order, *Digynia*, *Trigynia*, *Tetragynia*, *Pentagynia*, *Hexagynia*, *Heptagynia*, *Decagynia*, *Dodecagynia*, expressive of two, three, four, five, six, seven, ten, and twelve pistils, and

Polygynia, signifying many pistils, all refer to corresponding orders of the class in which such plants occur.

Didynamia, the 14th class, contains two orders: 1. *Gymnospermia*, so denominated from the seeds being naked, or uncovered, and they are almost always four in number, as in the dead-nettle; 2. *Angiospermia*, expressive of the seeds, which are numerous, being included in a capsule, or seed-vessel, as in foxglove and snapdragon.

Tetradynamia, the 15th class, has also two orders, which are determined by the form of the fruit: 1. *Siliculosa*, in which the fruit is a silicle, or roundish pod, as in shepherds-purse, and the common garden-cress; and, 2. *Siliquosa*, in which the fruit is a siliqua, or long pod, as in the pea tribe.

In the 16th, 17th, and 18th classes, Monadelphia, Diadelphia, Polyadelphia, the characters of the orders are taken from the number of the stamens, as in the first thirteen classes.

Syngenesia, the 19th class, comprehends five orders, the characters of which are taken from the florets, of which the compound flower is formed, being united or separated, barren, fertile, or abortive.

The first order, *Polygamia æqualis*, includes those plants in which all the florets have both stamens and pistils, and produce seeds, as in dandelion. 2. *Polygamia superflua*, in which the flowers consist of two parts, a disk, or central part, and radii, or rays, which project outward; the florets of the disk have stamens and pistil, and those of the rays have pistil only, but each of them produces perfect seed, as in the daisy, chamomile, and corn-marygold. 3. *Polygamia frustranea*, in which the florets of the disk have stamens and pistil, but those of the rays have only an abortive pistil, as in blue-bottle. 4. *Polygamia necessaria*, in which the florets of the disk are furnished with stamens only, and those of the radius with pistils only, as in garden-marygold. 5. *Polygamia segregata*, in which each of the florets has a proper calyx included in one general calyx, as in *echinops*, or globe-thistle. To this class Linnæus added a sixth order, *Monogamia*, in which the flowers are not compound, but single, as the word denotes; but as the union of the anthers is not always uniform, the plants belonging to this order have been arranged by later botanists under other classes, according to the number of stamens.

In the 20th, 21st, and 22d classes the orders are formed from the number of stamens, or from the character of some of the preceding classes.

Polygamia, the 23d class, includes three orders, formed upon the principles of the classes immediately preceding. 1. *Monœcia*, in which flowers with both stamens and pistils, or flowers with pistils or stamens only, grow on the same plant. 2. *Diœcia*, when two or three kinds of flowers appear on two separate plants. 3. *Triœcia*, in which the different flowers just described grow on three separate plants, of which the fig furnishes an example.

The 24th class, *Cryptogamia*, was divided by Linnæus into four orders, namely, ferns, mosses, flags, and mushrooms; but Dr Smith has added a fifth order. 1. *Filices*, or ferns, in which the fructification appears on the back, summit, or near the base of the leaf, which is denominated a frond. 2. *Musci*, or mosses, which have separate leaves, and often a stem, and are furnished with a calyptra, or hood-like corolla. 3. *Hepaticæ*, or liverworts, having the leaf and stem united, forming a frond, but the capsules do not open with a lid as in the mosses. In the 4th order, *Algæ*, or flags, the herb is a frond, and the seeds are imbedded in its substance, or in the disk of a peculiar receptacle. 5. *Fungi*, or mushrooms, have no leaves, and the fructification is in a fleshy substance.

Sect. III. *Of Genera and Species.*

The orders are again subdivided into genera. The characteristic marks of the genera are derived from the flowers and fruit, and a genus comprehends one or more species, which resemble each other in some parts of the flower or fruit, or of both. Three kinds of generic characters are mentioned by Linnæus, the factitious, essential, and the natural, all depending on the fructification alone, and not on the inflorescence or on any other part: by the factitious character, genera that come together in the same artificial order, or section, are discriminated; by the essential character, a particular genus is distinguished by one striking mark from all genera of the same natural order, and, consequently, from all other plants; and the natural characters include all the marks common to all the species of the genus. The natural character of genera is employed by Linnæus in his *Genera Plantarum;* but to this method of discrimination it has been objected, that it does not direct the mind to the most important marks, and that it only accords with such species of the genus as are known to the author, from which it is obviously imperfect; but the essential character, which is now universally adopted to distinguish genera, comprehends all the marks necessary to discriminate each genus from every other in the system.

The characters which are employed in distinguishing species should be constructed on the same principles as the characters of the genera, and they ought to be certain, clear, and concise. No characters ought to be adopted in the discrimination of the species which have been already enumerated among the generic marks. For the sake of brevity, Linnæus limited his specific definitions to twelve words, a rule which has been followed by succeeding naturalists, especially those who have employed the Latin language, in which it is most practicable.

In the construction of generic and specific characters, the arrangement of the different parts from which these marks are derived ought to be attended to. The most important in the natural order, or genus, are first mentioned, and the subordinate, or more particular marks of the object to which they are applied, ought to conclude the description; but in drawing up the natural characters of a genus, the calyx, corolla, stamens, pistils, seed-vessel, seed, and receptacle, are to be described in their order; and the root, stem, leaves, appendages, flower, and fruit, point out the arrangement, when a full description of any particular plant is required.

Of Sections.—The labour of research is greatly abridged and facilitated by associating together such genera and species as are allied by certain marks.

Such groups of genera and species are distributed into sections; and each section being particularly characterised, if it shall appear that the plant possesses the character of that section, after the class and order have been ascertained, and the genus to which it belongs is sought for, it is only necessary to compare it with the descriptions comprehended under that particular section. Thus the position of the germen furnishes marks for the formation of two sections in certain genera, which are characterised by having the flower superior or inferior, as when the receptacle of the flower is above the germen it is called superior, and when the receptacle is below the germen it is called inferior. The number of petals furnishes discriminative marks for the division of the genera of the 13th class into sections. In the 14th class, *Didynamia*, the character of the sections is derived from the calyx, which is said to be two-lipped, or bilabiated, when the mouth resembles two lips, and cleft when it is divided into so many parts. The pod being notched at the point, or being entire, in the first order of the 15th class, is the foundation of two sections; and the calyx being closed or open, affords characters for the two sections into which the second order is divided. The first order of the fourth class, in Smith's *Flora Britannica*, exhibits a good illustration of this division into sections. This order consists of five sections: In the first the flowers are monopetalous, one-seeded, and superior; in the second, they are monopetalous, two-seeded, and superior; in the third section the flowers are monopetalous, many-seeded, and inferior; in the fourth section the corolla has four petals; and in the fifth the flowers are apetalous, or want the corolla. An example of the distribution of the species belonging to the genus veronica, or speedwell, may be taken from the same work. This genus is divided into three sections, including, first, those species which have flowers in a spike; second, those whose flowers grow in clusters; and, third, those which have solitary flowers.

Sect. IV. *Method of investigating the Class, Order, &c. of a Plant.*

The principles of the Linnæan classification being distinctly understood, the examination of plants, for the purpose of ascertaining to what class, order, genus, and species they belong, is next to be attempted. Flowers in different states, some that are expanded, some not yet unfolded, and some which have ripened their fruit or seed, should be selected; and, in determining the class, the number, situation, proportion, or connection of the stamens, is to be considered. To assist the student in determining this point, reference may be made to Plate 28. in which the Roman numerals mark the classes. Fig. 1. represents one stamen inserted at the base of the germen. 2. Two stamens attached to the tube of the corolla. 3. Two stamens rising from the tube of the corolla. 4. Three stamens rising from the tube. 5. A B, a glume; C D, the chaff; D E, one of the valves of the chaff, terminated by an awn, three stamens with anthers bifid at the two extremities. 6. Four sessile anthers attached to the orifice of the corolla. 7. Four stamens rising out of it. 8. Five stamens alternating with the petals. 9. Five stamens opposite to the divisions of the corolla. 10. Five stamens with arrow-headed anthers attached to the corolla. 11. Six stamens alternating with the divisions of the perianth. 12. and 13. Six stamens with sessile anthers attached to the orifice of a globular perianth; A, is a limb with six teeth. 14. Seven stamens. 15. A spurred calyx; five petals with long claws. 16. Eight stamens; the germen central. 17. A calyx with three small leaves, the corolla with three petals, stamens nine. 18. The germen surrounded with nine stamens. 19. A monophyllous calyx calyculated, or with a small calyx at its base, and five petals. 20. Ten stamens supported on a cylindrical disk proceeding from the bottom of the calyx of Fig. 19. 21. Monophyllous calyx, five petals with two lobed laminæ and ten stamens. 22. Twelve stamens with double anthers and pedicellated germen. 23. Twelve stamens proceeding from a simple monophyllous perianth, the limb three-lobed. 24. The same perianth opened lengthwise. 25. A corolla with five petals, the stamens numerous. 26. A compound berry. 27. The stamens inserted on the calyx. 28. Stamens inserted at the orifice of the perianth, the germen globular, the style short, and the stigma rounded. 29. A flower with five petals and a great number of stamens. 30. Calyx of the flower, Fig. 29. separated from its petals, to shew the attachment of the stamens below the germen. 31. B, the part where the leaves of the calyx, the petals, and the stamens, were attached; A, many germens united into one head. 32. B, one-lipped corolla, the stamens didynamious; A, two-lipped corolla, the stamens didynamious, or two long and two short. 33. The calyx divided lengthwise, shewing a germen with four lobes becoming four small seeds, the styles slender, with a bifid stigma. 34. An irregular two-lipped corolla, with a spur. 35. The same opened lengthwise, to shew the didynamious stamens. 36. The capsule cut transversely, to shew the two cells and the seeds. 37. Tetradynamious stamens, or four long and two short, surrounding a slender pistil, surmounted by a stigma notched at the top. 38. A cruciform flower. 39. A silique, *siliqua*, or long pod. 40. Another cruciform flower. 41. Silicle, or short pod open. 42. Stamens united together in the class Monadelphia. 43. Corolla, with five petals notched at their summits. 44. The fruit divided into five small capsules, each surmounted by a part of the style which is permanent. 45. Ten stamens, of which nine are united and one is separated, indicating the class Diadelphia. 46. and 47. Papilionaceous flowers. 48. A legume, or pod of the pea tribe. 49. A corolla with five petals, the stamens united in three parcels, A B C, as in the class Polyadelphia. 50. A B C, a floret; A, the stamens united by the anthers, the character of the Syngenesia class; B, the tubulated perianth formed of the petals; C, feathered seeds. 51. A, The style coming from the tube of the united anthers; C, the limb lengthened into a strap called a ligulated flower. 52. A compound, radiated, or rayed flower. 53. A, An involucrum, or common calyx; B, a common receptacle; C, feathered seeds; E, the down; D, the foot stalks. 54. A simple irregular perianth, attached by its base to the germen;

B, the germen; A, six sessile anthers fixed on the style, denoting the class Gynandria. 55. An irregular polypetalous flower, with the anthers united by the filaments. 56. A monœcious plant; A, the flowers with stamens, and B, the flowers with pistils, both growing on the same plant. 57. A, Flower with stamens; B, Flower with pistils. 58. A, Flower with stamens; B, Flower with pistils. 59. A, Flower with stamens; B, Flower with pistils; and C, Flower with both stamens and pistils, on the same or different plants. 60. A moss. 61. A mushroom.

Inflorescence.—The inflorescence, or mode of flowering, that is, the distribution of the flowers on plants, afford useful discriminating marks; and of these, different kinds have received appropriate names.

When the flowers surround the stem in a kind of ring, it is called *verticillus*, or whorl, as in dead-nettle and wild marjoram.

A cluster, or raceme, *racemus*, is composed of numerous rather distant flowers, each having its own proper stalk, but all arising from a common stalk, as in red currants. *Solanum dulcamara*, bitter-sweet, exhibits an example of a compound raceme; and *actæa racemosa* produces an aggregate raceme, where several are collected together.

The spike, *spica*, is characterised by numerous flowers on a common stalk, without partial stalks, as in broad-leaved plantain. Sometimes the spike is compound, as in *lavandula pinnata;* and when the flowers are all on one side, it is called *spica secunda.* A spicula, or spikelet, is applied to the grasses which have many florets in one calyx, as in *poa aquatica.*

Corymbus, or corymb, is a spike with partial flower-stalks, gradually longer as they are lower on the common stalk, so that all the flowers are nearly on a level, as in the common cabbage, which becomes a raceme when it is in fruit.

Fasciculus, or fascicle, is applied to flowers which have little stalks variously inserted and subdivided, but collected into a close bundle, which is level at the top, of which common sweetwilliam is a good example.

Capitulum, a head or tuft, has sessile flowers arranged in a globular form, as in sea-pink and globe-amaranthus.

Umbella, or umbel, has several flower-stalks or rays, nearly of equal length, rising from a common centre, and the summits forming a level, convex, rounded, and rarely a concave surface. It is called a simple umbel when each ray has a single flower, and compound when each stalk or ray supports a small or partial umbel. This peculiar distribution of the flowers is the origin of the name of a natural order of plants, which are thus denominated *umbellated*, or *umbelliferous*, as the common carrot, parsley, and hemlock.

Cyma, or *cyme*, agreeing in general appearance with the umbel, has the stalks arising from one centre, but variously and alternately subdivided, as in the common laurus-tinus and elder.

Panicula or *panicle*, has the flowers in a loose subdivided bunch or cluster, without order. When the stalks are distant, it is called a spreading panicle, as in London-pride, *saxifraga umbrosa*, and in the common cultivated oat. When the panicle is more crowded it is called dense or close, and when more spreading, it is said to be divaricated.

Thyrsus, a bunch, is a dense or close panicle, approaching to an ovate form, as in the common lilac; *tussilago petasites*, or common butter bur, is also an example of the thyrsus.

Stems.—A flower-stalk is said to be solitary when it bears one flower, clustered, in which several stems are united together; radical, when they arise from the root; cauline, when they spring from the stem; axillary, when they grow from the axillæ of the leaves; and lateral, or terminal, as they proceed from the side or extremity of the stem.

Culmus, Culm, or Straw, is the stem peculiar to the grasses, rushes, and similar plants. It is either without joints, as in the common rush; jointed, as in most of the grasses; geniculated, or kneed, as in a common species of fox-tail grass.

Scapus, or stalk, is that stem which springs from the root, and supports the flower and seed, but not the leaves, as in the common primrose.

Pedunculus, is the flower-stalk which springs from the stem, and supports the flowers and fruit, but not the leaves.

Petiolus, or petiole, is the foot-stalk of the leaf, and is a term exclusively appropriated to leaves; and it is either simple or compound, as it supports one or more leaves.

Frons, or frond, is a term applied to the leaves of ferns, in which the stem, leaf, and parts of fructification are united.

Stipes, or stipe, is the term applied to the stem of a frond, and to the stalk of a mushroom; the stipes in ferns is commonly scaly.

Leaves.—In the description of plants, and particularly in the discrimination of species, the forms of leaves afford obvious characters, and therefore merit attention. Leaves are properly distinguished into simple and compound. Plate 29. exhibits a view of the forms of simple leaves; Fig. 1. is an elliptical leaf; 2. an oval pointed leaf; 3. an oval reversed; 4. oblong; 5. linear and lance-shaped; 6. awl-shaped; 7. thick linear; 8. linear; 9. arrow-headed; 10. triangular; 11. crescent-shaped; 12. kidney-formed; 13. round kidney-formed; 14. rounded and crenulated; 15. five lobed; 16. four lobed; 17. three lobed; 18. heart-shaped reversed; 19. halbert-shaped; 20. arrow-headed and blunt at the summit; 21. runcinated; 22. with seven or eight toothed lobes; 23. seven lobed with two small ears, rounded at the base; 24. with five divisions nearly palmated; 25. trifid and bitten; 26. with five divisions, palmated; 27. oblong, crenulated, and wrinkled; 28. rounded, with nine lobes not deep, and toothed; 29. plaited, with seven toothed lobes; 30. seven lobed; 31. sinuated and toothed; 32. lance-shaped, and serrated, or toothed like a saw; 33. heart-shaped, oval, and serrated; 34. cylindrical and fistulous, or hollow; 35. rounded, oval, and doubly toothed; 36. palmated, the divisions notched at the summit; 37. rounded, oval, toothed; 38. rounded, elliptical, crenulated; 39. a, slightly sinuated, b, sinuated; 40. heart-shaped, serrated; 41. oblong, oval, serrated; 42. rounded, sinuated, peltated; 43. round, peltated; 44. lyre-shaped, or lyrated; 45. notched at the summit; 46. oval, bifid at the sum-

Linnæan Classification.

mit; 47. oval, pointed; 48. petiolated, rounded, heart-shaped, and dotted; 49. oval, lance-shaped, slightly sinuated; 50. three-cornered, pyramidal; 51. heart-shaped, pointed; 52. oval, five-nerved; 53. pointed, oval, three-nerved; 54. oblong, lance-shaped, half embracing the stalk; 55. fleshy, linear, cylindrical, and rough with points; 56. divided into five segments; 57. dotted, succulent, spatulated; 58. fiddle-shaped; 59. halbert-shaped, and double-eared; 60. angular, equally sinuated; 61. united; 62. elliptical, oval, crenulated; 63. arrow headed, triangular, bitten; 64. rhomboidal; 65. oblong, with two small pointed ears on the foot stalk; 66. pinnatifid; 67. arrow-headed, embracing; 68. perfoliated, sharp, oval; 69. long linear, sheathing at the base, a, b, the sheath.

Plate 30. presents a view of the forms of compound leaves: Figure 1. a leaf composed of four oval serrated leaves; 2. three reversed oval leaves, toothed; 3. two opposite leaves; 4. five-fingered serrated leaf; 5. nine digitated leaflets, oval, lance shaped, and serrated; 6. five reversed, oval, and serrated leaflets; 7. pennatiform, interrupted, with the pinnæ serrated; 8. pinnated, with an odd leaf, the pinnæ opposite; 9. eight lance-shaped pinnæ, serrated, and pedated; 10. pinnated, without an odd one, the pinnæ alternate; 11. pinnated without an odd one, the pinnæ opposite; 12. pinnated, with an odd one, the pinnæ alternate; 13. a winged stem, articulated, with sessile leaves at the articulations; 14. with opposite lance-shaped pinnæ, the foot-stalk terminating in a tendril; the stipulae arrow-headed; 15. pinnated, with opposite pinnæ, and terminated by a tendril; 16. with six pinnæ, without an odd one, the common foot-stalk winged; 17. twice pinnated, with heart-shaped pinnæ; 18. twice pinnated, with unequal pinnæ; 19. twice pinnated, without an odd leaflet; 20. triply pinnated; 21. triply pinnated, with an odd leaflet; 22. triply pinnated, with an odd leaflet, with pointed oval pinnæ; 23. a decompounded leaf.

Roots.—Roots sometimes afford specific names to plants, so that their forms and diversities require attention in descriptions.

A fibrous root, *radix fibrosa*, is the simplest kind, and is composed of fibres which are either undivided or branched. This kind of root is peculiar to many grasses, and to most annual plants.

A creeping root, *radix repens*, is considered as a kind of underground stem, which shoots out horizontally, and throws off fibres in its course. Couch-grass, and the common bent on sand hills near the sea, are excellent examples of this kind of root, to which may be added common mint.

A fusiform, or spindle shaped root, *radix fusiformis*, is of a tapering form, and penetrates perpendicularly into the ground, as in the carrot, the parsnip, and radish.

An abrupt root, *radix præmorsa*, has somewhat of a spindle-shape, but it is abrupt or bitten off at its extremity, as in *scabiosa succisa*, devils bit scabious.

A tuberous or knobbed root, *radix tuberosa*, is composed of fleshy knobs, connected by common stalks or fibres, as in *solanum tuberosum*, the potatoe, and *helianthus tuberosus*, or Jerusalem artichoke.

A bulbous root, *radix bulbosa*, is either solid, as in the crocus,—or composed of concentrical layers, as in the onion,—or scaly, consisting of fleshy scales attached at the base, as in the white and orange lily.

Monandria.

A jointed or granulated root, *radix articulata*, or *granulata*, is composed of a number of small grains, or fleshy knobs, as in *saxifraga granulata*, white saxifrage, and *oxalis acetosella*, or wood-sorrel.

Chap. II. Illustration of the Classes.

In the selection of examples for illustrating the classification, the preference has been given to such plants as are most common, or most accessible, whether they are found indigenous, cultivated in the garden, or require the shelter of the green-house or stove; in some the choice has been determined by peculiarity of structure or habits, or the valuable uses to which they are applied as food, or in the arts of life; and such notices of their natural history are occasionally introduced, as may enable the student to extend his view of the diversified objects of the vegetable kingdom beyond the limits of mere nomenclature.

Class I. Monandria. One Stamen.

This class includes two orders.

Order I. Monogynia.

In the distribution of the genera belonging to this order, four sections are formed. Sect. 1. contains the natural order called *scitamineæ*, or spicy plants, all which are exotics, and they are distinguished by having the germen inferior, and having one or two cells; sect. 2. germen inferior, and four-celled; sect. 3. germen superior; sect. 4. one-seeded.

Hedychium *Coronarium*, Sweet-scented Garland Flower. *Gen. char.*—Calyx, one-leaved, bursting; tube of corolla very long; limb double, tripartite; nectary two-leaved. This fragrant flower is snow-white, is a native of India, and is much cultivated in the Malaccas; requires the heat of a stove in this country, and is met with in some of the gardens near London.—*Bot. Mag.* 708.

Amomum *Zinziber*, Ginger. *Gen. char.*—Cal. three-cleft, unequal, cylindrical; corolla tripartite, unequal, spreading; nect. two-lipped, and somewhat erect. *Spec. char.*—Scape naked, spike and scales ovate, leaves lance-shaped, and ciliated on the margin near the summit. This plant has something of the habit of a grass in its appearance, and it grows to the height of two, and sometimes three feet; it is a native of the East Indies, and is extensively cultivated in the West Indies, where it is planted in March or April, flowers about September, and, when the stalks have withered about the end of the year, the roots are dug up in January and February following.

The roots of ginger, on account of which it is cultivated, furnish a well known and excellent spice. Two kinds are met with in commerce, the black and the white ginger. They are the roots of the same plant, and differ only in the selection and mode of curing. The larger roots are chosen for the white ginger; and each root being washed and scraped separately, is dried in the sun. The whole of the remaining roots of the crop, after being picked and cleaned, are put into baskets, dipped into boiling water, and after being scalded, are dried on a platform, and put up in bags for the market, under the name of black ginger.

The young roots of ginger constitute one of the most delicious preserves. When intended for this purpose, the roots are dug up while they are tender and full of sap, carefully picked and washed, and after being scraped and peeled, they are put into jars, and covered with syrup, which is sometimes shifted two or three times.

Canna *Indica*, common Indian Reed, or Indian Shot; the first name derived from the appearance of its stem and leaves, and the second from its hard round seeds, resembling lead shot, and employed, it is said, by the Indians for the same purpose; is a native of both the Indies, and is often cultivated in the gardens of Europe on account of the beauty of its foliage and flowers; but it requires artificial heat. *Gen. char.*—Cal. three-leaved; cor. six-parted, erect, with a two-parted revolute lip; style lance-shaped, adhering to the corolla. *Spec. char.*—Leaves ovate, acuminate, and ribbed. Several varieties of this beautiful plant are enumerated, some of which have yellow flowers. Plate 31. Fig. 1.

Salicornia. *Gen. char.*—Cal. entire, ventricose; cor. none; one seed, covered by the calyx.

Sal. *Herbacea*, Jointed Glasswort, or Saltwort. Knees compressed, emarginate, joints obconical, spikes with footstalks, tapering towards the top.

Sal. *Fruticosa*, Shrubby Samphire, or jointed Glasswort; knees round, entire, joints equal, spikes subsessile. Both these species are natives of Britain and grow in salt-marshes near the sea. They flower in August and September, and the first is annual or biennial, and the last perennial.

Hippuris *Vulgaris*, Mare's-tail. *Gen. char.*—Cal. indistinct, entire; cor. none; stigma simple; one seed, inferior. *Spec. char.*—Leaves linear, in whorls. Native of Britain, in ditches and stagnant pools, but not very common. Near Lynn, and other parts of Norfolk, and at the edge of Duddingston-loch near Edinburgh. Perennial, and flowers in May. This plant is easily distinguished by its spreading linear leaves, from eight to twelve in the whorl, and by the single stamen rising from the base of the leaf, or the single seed at a later period of the season.

Order II. Digynia.

Callitriche.—*Gen. char.*—Cal. none; petals two; stigmas acute; seeds four, compressed, naked, margined on one side.

Call. *Aquatica*, Water Starwort; an annual plant, common in the ditches or stagnant waters of Britain; is in flower from April to October, and is easily distinguished by its floating leaves and small white sessile, solitary and axillary flowers. Two species, *verna* and *autumnalis*, have been described; but they are considered as only varieties, the latter of which is distinguished by all the leaves being uniformly linear.

Blitum. *Gen. char.*—Cal. three-cleft; petals none; one seed in a berried calyx.

Blit. *Virgatum*, Strawberry-blite. Little heads, sparse, and growing from the sides of the stem. This species, which is a native of Spain and Tartary, and was first introduced into this country in 1759, is now well known among the hardy annuals of every garden under the name of Strawberry Spinach, a name derived from the beautiful red colour of its berries, and the form of its leaves.

Observ.—It sometimes happens, that a plant, from the parts of fructification that determine the class, should be arranged in a different class from those species with which it agrees in all other respects. To mark the anomaly, and at the same time to retain the plant in its place among those species with which it is naturally allied, Linnæus has ingeniously contrived to introduce it after the generic characters of the order and class to which it belongs. Thus, the genus *Tradescantia* belongs to the sixth class; but one species has only a single stamen, and therefore belongs to the first class, and to the third section of the first order of that class, at the end of which it is set down with its specific name, thus, *Tradescantia monandra*. According to the same plan, *Valeriana rubra*, and *Angustifolia*, have only one stamen and one seed, and are therefore noted at the end of the fourth section of the first order of the first class, but retain their place among the species to which they are naturally allied, in the first order of the third class.

Class II. Diandria. Two Stamens.

This class is divided into three orders.

Order I. Monogynia.

Jasminum, Jasmine. *Gen. char.*—Cor. five-cleft; berry two-seeded; seeds in a seed-coat; anthers within the tube.

Jas. *Officinale*, Common Jasmine; with opposite pinnated leaves, leaflets sharp pointed. The common jasmine, which is a native of Switzerland and India, recommends itself by the beauty of its leaves, and the fragrance of its flowers, and finds a place in every garden.

Jas. *Odoratissimum*, Sweetest Jasmine; with leaves alternate, bluntish, ternate, and pinnated; a native of Madeira, but common in the greenhouses of this country, and displaying its yellow flowers from May to November. The trivial name is far from being appropriate, for it is inferior in fragrance to the common jasmine.

Jas. *Fruticans*, Yellow or Berry-bearing Jasmine; with alternate, ternate, and simple leaves, and angular stems, leaflets ob-ovate; a native of the Levant and the south of Europe; is easily distinguished by the rich green of the foliage, and fine yellow colour of the blossoms, which are succeeded by black berries.

Diandria.

Ligustrum, Privet. *Gen. char.*—Cor. four-cleft; berry superior, two-celled, four-seeded.

Lig. *Vulgare*, Privet, or Prim-print; leaves elliptical, lance-shaped, obtuse, and somewhat dagger-pointed. This beautiful evergreen is a native of Britain and other parts of Europe, and shews its white flowers in May and June, which are succeeded by black berries of a very bitter taste.

Syringa, Lilac. *Gen. char.*—Cor. four-cleft; caps. two-celled.

Syr. *Vulgaris*, Common Lilac; with entire, ovate, heart-shaped leaves. This fine shrub, a native of Persia, is universally cultivated in this country, and is always admired on account of the beauty of its large bunches of blue, violet, or white flowers, which appear in different varieties.

Syr. *Persica*, Persian Lilac; with entire, lance-shaped leaves; is also, as the name indicates, a native of Persia, but is common in the gardens of Europe; is a shrub of humbler growth, and produces a large panicle of flowers of a pale purple colour.

Fraxinus. *Gen. char.*—Cal. none, or four-parted; cor. none, or four-parted; caps. superior, two-celled, leafy above, and compressed; seed solitary, pendulous.

Frax. *Excelsior*, Common Ash-tree; with serrated leaflets, and flowers destitute of calyx and corolla. This lofty tree, which is met with every-where, affords a fine example of pinnated leaves terminated by an odd leaflet, and is remarkable for the lateness of its frondescence, or coming into leaf. It flowers in April and May, and the large dark-purple anthers fall off before the leaves are unfolded.

The variety with pendulous branches, called Weeping ash, is also well known.

Circæa. *Gen. char.*—Cor. two-petaled; cal. two-leaved, superior; caps. two-celled; seed solitary.

Cir. *Lutetiana*, Common Enchanters Nightshade; with erect stem, and leaves ovate, toothed, opaque, pubescent; is common in woods and moist shady places of Britain, and flowers in June and July.

Veronica, Speedwell. *Gen. char.*—Cor. four-cleft, wheel-shaped, the lowest segment narrower; caps. superior, two-celled.

Ver. *Spicata*, Spiked Speedwell; spike terminal, with opposite bluntish-notched serrated leaves, which are very entire at the extremity of the stalk, ascending, and very simple; grows in meadows and elevated pastures with a calcareous soil, in England, as at Newmarket-heath, and Penny-bridge, Lancashire; perennial, and flowers in July.

Ver. *Serpyllifolia*, Thyme-leaved or Smooth Speedwell; with a terminal raceme, approaching to a spike; leaves ovate, slightly notched, smooth, and three-nerved; is common in meadows and pastures of Britain, and flowers in May and June.

Ver. *Becabunga*, Brooklime; with lateral racemes, plain, elliptical leaves, and creeping stem; is not uncommon in rivulets, and ditches with clear water; is perennial, and flowers in July.

Ver. *Anagallis*, Water Speedwell or Long-leaved Brooklime; with opposite lateral racemes, lanceolated serrated leaves, and upright stem; is not uncommon in ditches and marshes of this country; flowers in July; and is easily distinguished from the former by its lanceolate leaves and erect stem.

Ver. *Chamædrys*, Germander Speedwell, or Wild Germander; racemes lateral, leaves ovate, sessile, wrinkled, serrated, the stem hairy on two sides; very common in meadows and pastures, and under warm hedges; flowers in May and June, and is easily recognised by its beautiful blue flowers.

Ver. *Hederifolia*, Ivy-leaved Speedwell; with solitary flowers, heart-shaped, plain, five-lobed leaves, segments of the calyx heart-shaped, seeds pitcher-shaped; annual, and very common in gardens and fields; flowering from April to September.

Verbena, Vervain. *Gen. char.*—Cor. funnel-shaped, nearly equal; curved calyx with a single truncated tooth; seeds two or four, as the stamens are two or four, which happens in the species of this genus.

Ver. *Aubletia*, Rose-Vervain; with 4 stamens, loose solitary spikes, and trifid notched leaves; native of North America; is biennial; flowers in June and July; and the brilliancy of its scarlet flowers renders it a charming ornament of the greenhouse. Plate 31. Fig. 2.

Ver. *Triphylla*, Three-leaved Vervain; tetrandrous, flowers paniculated, leaves ternate, stem shrubby; native of South America, and common in the green-house, where it is easily recognised by the three leaves in a whorl, and the agreeable fragrance which every part of the bruised plant emits. *Bot. Mag.* II. 367.

Rosmarinus *Officinalis*, Common Rosemary. *Gen. char.*—Cor. unequal, upper lip two-parted, filaments long, curved, simple, with a tooth. *Spec. char.* Leaves sessile. Native of south of Europe, but common in gardens, where its large flowers afford an easy investigation.

Salvia. *Gen. char.*—Cor. unequal, filaments two, short, transversely attached to a small footstalk.

Sal. *Verbenacea*, Wild English Clary; leaves serrated, sinuated, and somewhat smooth; the corolla narrower than the calyx. In dry stony places in Britain; perennial; flowers from June to October.

Sal. *Horminum*, Purple-topped Clary; with blunt crenated leaves, and with bracteas at the top of the stem, coloured and larger. Native of Greece; but is well known as an annual in the flower-garden by its blue and purple tops, which are sometimes taken for flowers.

Order II. Digynia.

Anthoxanthum *Odoratum*, Sweet-scented Vernal Grass. *Gen. char.*—Cal. a glume with two valves including one flower; cor. a two-valved glume, awned. *Spec. char.* Spike ovate-oblong, the florets on little footstalks longer than the awn. This grass is very common in meadows and pastures, flowers in May, and communicates a fine fragrance to hay; and is a remarkable exception to the tribe of grasses which have three stamens, and are therefore arranged under the third class.

ORDER III. TRIGYNIA.

PIPER, *Gen. char.*—Cal. none; cor. none; berry roundish, containing one seed.

Pip. *Nigrum*, Black Pepper; leaves ovate, seven-nerved, smooth, foot-stalks simple. This plant, which is shrubby and creeping, is a native of the East Indies, and is extensively cultivated in Java and other places, on account of the berries which afford the black pepper of commerce, and are well known by their hot and aromatic taste as a spice or condiment. The berries are collected before they are ripe, and, being dried in the sun, become wrinkled and black, and are known under the name of black pepper; but when the fruit is fully ripe, and the external coat is separated by maceration in water, the berry exhibits a smooth surface, is less hot to the taste, and is the white pepper of commerce.

The species belonging to this genus are very numerous, and some of them are natives of Jamaica and the other islands in the West Indies, of South America, and of the South sea islands.

CLASS III. TRIANDRIA. Three Stamens.

This class is divided into three orders.

ORDER I. MONOGYNIA.

VALERIANA. *Gen. char.*—Cal. none; cor. monopetalous; gibbous at the base on one side, superior; one seed.

Val. *Dioica*, Small or Marsh Valerian; flowers triandrous, diœcious, (that is, the stamens on one plant and the pistils on another,) radical leaves ovate, stem leaves pinnated. Native of Britain; grows in wet and marshy meadows; is perennial, and flowers in June.

Val. *Officinalis*, Great Wild Valerian; flowers triandrous, leaves pinnated, leaflets lance-shaped, nearly uniform; a common plant on the banks of rivers and in marshy places; is perennial, and flowers in June. The roots of this plant are employed in medicine, and are well known for a peculiar odour which seems to be extremely grateful to some animals; cats are very fond of it, and it is said also that rats are attracted by the smell.

CROCUS. *Gen. char.*—Cor. six-parted, superior, tube very long, stigma convolute, eroded, spathe one-valved, radical.

Croc. *Sativus*, Saffron Crocus; with tripartite produced stigma, segments linear; flowers in September, and is extensively cultivated in Cambridgeshire, and about Saffron Walden in Essex, from which it has spread to the neighbouring fields, and grows in meadows and pastures. The summits of the pistils are collected and dried, and constitute the saffron of the shops.

Croc. *Vernus*, Spring or Garden Crocus; with trifid included stigma, and deeply cut wedge-shaped lobes; flowers in March, and is well known as one of the earliest ornaments of the parterre, where it appears with purple, white, and yellow flowers.

Croc. *Nudiflorus*, Naked Flowering Crocus; with trifid included stigma; is remarkable for the flower appearing in autumn without the leaves, from whence it is called autumnal and naked crocus.

IRIS. *Gen. char.*—Cor. six-parted, superior; the petals alternately reflected; stigmas petal-shaped.

Ir. *Pseudacorus*, Yellow Iris, or Water Flower-de-luce. Cor. without beards; interior petals less than the stigma; leaves sword-shaped; perennial; flowers in July, and is very common in wet ground.

Ir. *Fœtidissima*, Gladwin or Stinking Iris.—Cor. without beards, interior petals very spreading, stem one-angled, leaves sword-shaped; in shady woods and hedges; not uncommon in the west of England; perennial, flowers in June, and is easily recognized by its unpleasant odour.

Ir. *Persica*, Persian Iris; cor. unbearded, interior petals very short, spreading horizontally: A native of Persia, and a great favourite with the florist for its early appearance in February or March, and the beauty and fragrance of its flowers.

Ir. *Florentina*, Florentine Flag; cor. bearded, with pale green leaves shorter than the stem. Native of Italy and the south of Europe; grows abundantly on the walls of Florence, and is planted about graves in Algiers. The dried root furnishes the orris powder of commerce, which is extensively employed as a perfume. *Bot. Mag.* xviii. 671.

Ir. *Lurida*, Dingy Flag; bearded, with a stem nearly one-half longer than the leaves; native of the south of Europe, is cultivated in gardens, and flowers in May. *Bot. Mag.* xviii. 669. and Plate 31. Fig. 3.

Ir. *Susiana*, Chalcedonian Iris; with smooth, sword-shaped leaves, scape one-flowered, petals rounded; is a native of Persia, as the trivial name imports, and is the most magnificent of the Iris tribe; is cultivated in gardens, but is impatient of moisture, and flowers in June. *Bot. Mag.* iii. 91.

SCHOENUS. *Gen. char.*—Glumes chaffy, crowded, the exterior barren; cor. none; one seed, roundish.

Sch. *Mariscus*, Prickly or Long-rooted Bog-rush; with a round stem, and leaves acutely serrated on the margin and back; native of England, grows in marshes, and is very common on the moors near Cambridge.

Sch. *Albus*, White-headed Bog-rush; with a leafy triangular stem, flowers fasciculated, and bristly leaves; common in marshy places, particularly in Scotland; is perennial, and flowers in August.

Many species belonging to this genus are natives of tropical regions, particularly *restioides* and *cladium*, the former of which grows to the height of six feet, and the latter from eight to ten feet, in moist places and sea-marshes in Jamaica.

CYPERUS. *Gen. char.*—Glumes chaffy, imbricated on two sides; cor. none; one seed, without awn.

Cyp. *Longus*, Sweet Cyperus, or English Galingale; with a leafy triangular stem, a leafy divided umbel, naked peduncles, and alternate spikelets; perennial, and flowers in July; is a rare plant in England, but is met with in the isle of Purbeck, and near St David's Head.

Many species belong to this genus, chiefly natives of warm climates.

Cyp. *Elegans,* is a splendid species which grows in the sea-marshes near Lignanea in Jamaica. The root-leaves are from two to three feet in length, the stalk rises two feet and a half, with two or three leaves on the top, one of which is a foot long; and the elegant panicle is composed of numerous spikelets, some of which are sessile, and some are elevated on peduncles three or four inches long.

Cyp. *Odoratus,* Sweet-scented Cyperus, a native of low lands in the same island, exceeds five feet in height. Cyp. *Papyrus,* a native of Egypt, is still a loftier plant, which is alluded to by the ancients, and seems to have furnished the first materials for the manufacture of paper.

Scirpus. *Gen. char.*—Glume chaffy, imbricated on all sides; cor. none; one seed.

Scir. *Palustris,* Marsh-creeping Club-rush; with a round stem, sheathed at the base, spike terminal, nearly oval, glumes acute, root creeping; very common in ditches, marshes, and small streams; is perennial, and flowers in June and July.

Scir. *Lacustris,* Bull-rush; stem round, naked, panicle cymose, terminal, spikelets ovate; is common in clear water, as in still rivers and lakes; is perennial, flowers in July, and rises to the height of four or five feet.

The Bull-rush is also a native of Jamaica, where it is employed, as in England, in thatching cottages and stuffing chair-bottoms.

This is also a very numerous genus, the species of which are spread over the southern parts of Europe, the East and West Indies, and America.

Eriophorum, Cotton-grass. *Gen char.*—Glumes chaffy, imbricated on all sides; cor. none; seed one, surrounded with very long wool.

Er. *Vaginatum,* Single-headed Cotton-grass; with round sheathed stems, solitary spike, and membranous glumes; perennial, flowers early in the spring, and is common in marshy and boggy places throughout Britain.

Er. *Polystachion,* Broad-leaved Cotton-grass; with round stems, plain leaves, and spikes with foot-stalks; is perennial; flowers in April, and is equally common.

Er. *Angustifolium,* Common Cotton-grass; with round stems, grooved leaves, triangular at the top, and spikes on foot-stalks; grows in similar places with the preceding.

Nardus *Stricta,* Mat-grass. *Gen. char.*—Cal. none; cor. a two-valved glume. *Spec. char.*—Spike setaceous, upright, with the flowers on one side. Perennial; flowers in July, and is very common in moist sandy heaths. This grass is separated from its natural family by having only one pistil.

Order II. Digynia.

This order includes almost the whole of the valuable tribe of grasses, which either grow up spontaneously, or are cultivated for the sake of their leaves as food for domestic animals, or for the sake of their seeds as food for man. A few of the more common may be noticed.

Phleum. *Gen. char.*—Cal. two-valved, truncated acuminated, sessile, one flowered, including the corolla.

Ph. *Pratense,* Common Cats-tail Grass, or Timothy-grass; with a very long cylindrical spike, the glume ciliated on the back, longer than the awn; perennial; flowers from June to October, and is common in meadows and moist pastures. This grass sometimes rises to the height of three or four feet.

Alopecurus, Fox-tail Grass. *Gen. char.*—Cal. two-valved; one flowered; cor. one-valved.

Al. *Pratensis,* Meadow Fox-tail Grass; with a smooth erect stem, spike somewhat lobed; glumes of the calyx villous, and united at the base; perennial; flowers in May, and is very common in meadows and pastures.

Al. *Geniculatus,* Floating Fox-tail Grass; with an ascending kneed stem, spike slightly lobed and cylindrical, glumes hairy, retuse; perennial; flowers in July, and is common in pools and watery places.

Agrostis. *Gen char.*—Cal. two-valved, one-flowered, valves acute; cor. two-valved, unequal, larger than the calyx; stigmas plumose.

Ag. *Vulgaris,* Fine Bent-grass; with a spreading panicle, the little branches capillary, divaricated, calyces equal, the interior petal one-half shorter; perennial; flowers in July, and is common in meadows and pastures.

Ag. *Stolonifera,* Creeping Bent-grass; panicle compact, with a branchy creeping stem, florets crowded, calyces equal, downy; perennial; flowers in July and August, and is common in moist meadows. This is the celebrated fiorin-grass, which has been most injudiciously and erroneously recommended for all soils and situations.

Ag. *Alba,* Marsh, or Wood Bent-grass; with a loose panicle and creeping stem; perennial; flowers in July, and grows in ditches and marshy places. This species has been also cultivated as fiorin grass.

Poa. *Gen. char.*—Cal. two-valved, many flowered, spikelets rounded at the base; cor. two-valved, ovate, valves somewhat acute.

Poa *Trivialis,* Roughish Meadow-grass; panicle diffuse, spikelets three-flowered, glumes lance-shaped, five-nerved, straw upright and rough; perennial; flowers through the summer, and very common in meadows and pastures.

Poa *Annua,* Annual Meadow-grass; panicle divaricated, spikelets ovate, and chiefly four-flowered, with an oblique compressed stem; flowers through the whole summer, and is one of the most common grasses.

Stipa *Pennata,* Feather-grass. *Gen. char.*—Cal. two-valved, one flowered; cor. exterior valve, with a very long terminal awn, articulated at the base. *Spec. char.*—Awns woolly; perennial; flowers in July; and is cultivated in the garden on account of its beautiful awns.

Avena. *Gen. char.*—Cal. two-valved, many flowered; cor. exterior valve awned on the back, awn twisted.

Av. *Fatua,* Wild-oat, or Haver; paniculated, calyx containing about three flowers, the florets hairy at the base, and all of them awned, and without nerves;

annual; flowers in August, and is not uncommon in fields and among corn.

To this genus belong the numerous varieties of the cultivated oat, beside many other species, some of which are native and some are exotic.

Arundo *Phragmites*, Common Reed. *Gen. char.* Cal. two-valved, florets surrounded with persistent down. *Spec. char.*—Cal. five-flowered, panicle lax. Perennial; flowers in July, and is well known as a native of ditches, stagnant waters, and banks of rivers.

Saccharum *Officinarum*, Sugar-cane. *Gen. char.* Cal. two-valved, covered with down at the base, one-flowered; cor. two-valved. *Spec. char.*—Flowers panicled, and flat leaves. This valuable vegetable is a native of India, South America, and the South-sea Islands; was introduced into Europe, it is supposed, during the crusades in the 12th century; and was planted in Spain, Madeira, the Canary, and Cape de Verd Islands, soon after their discovery in the 15th century; and from some of these islands found its way to the West Indies, where it is now so extensively cultivated. Several varieties of this plant are known; and, in the year 1796, a new variety, called the Bourbon, or Otaheite cane, of a larger size, and more productive, was introduced into Jamaica.

A rich, deep, and open soil, is the most suitable for the culture of the sugar-cane. Trenches, six or eight inches deep, and at the distance of three feet and a half, are formed; and the cuttings of the canes, having five or six joints, are placed horizontally at the bottom of the trench, and covered with mould to the depth of two inches. The sprouts appear in twelve or fourteen days; and as they shoot up the soil is gradually drawn about them, till, in the course of a few months, the ridges of earth are all level.

The cane-plant, including its leaves and flower stem, rises to the height of twelve or fourteen feet; and when it arrives at maturity, which requires the period of a year or fourteen months, the canes are cut down, and the leaves and top being separated, the solid stems are tied up in bundles and carried to the mill, where they are passed through iron-plated rollers, and the juice is received in a proper vessel, from which it is conveyed to boilers, where it is boiled down and concentrated; a quantity of quicklime is added, to separate some acid, which would prevent the crystallization, and some blood, or similar animal matter, is mixed with it, for the purpose of clarifying the liquid. When it is sufficiently concentrated and purified, the syrup is conveyed to coolers, where the sugar crystallizes, and the molasses separate. The sugar is then carried to the hogsheads in the curing-house, the bottoms of which are perforated that the molasses may drain off into a cistern below; and when the sugar is sufficiently dry it is brought to market under the name of *muscovado*, or *raw sugar*.

To this order also belong those plants which come under the denomination of *cerealia*, or those which produce corn, such as wheat, barley, rye, and oats; one species of which has been already mentioned.

Order III. Trigynia.

Montia *Fontana*, Water Chickweed.—*Gen. char.* Cal. two-leaved; cor. monopetalous, irregular; caps. one-celled, three-valved, three-seeded. This is the only species. It is annual; flowers in April and May, and is not uncommon near springs and moist places.

Holosteum. *Gen. char.*—Cal. five-leaved; petals five eroded; caps. 1-celled, nearly cylindrical, opening at the top.

Hol. *Umbellatum*, Umbelliferous Chickweed; with umbellated flowers. Is annual; flowers in April, and is sometimes met with on old walls, as the walls of Norwich. Several other species are natives of tropical regions.

Class IV. Tetrandria,

With four stamens and three orders.

Order I. Monogynia.

Dipsacus. *Gen. char.*—Common calyx many-leaved, foliaceous; proper calyx superior, one-leaved, down cup-formed.

Dip. *Fullonum*, Cultivated or Fuller's Teasel; leaves connate, or united at the base, the chaff bent back, involucrum reflexed. This fine plant, which grows to the height of five feet, is biennial; flowers in July, and is cultivated on account of its heads, which are employed in the woollen manufactures to raise the nap of cloth.

Dip. *Sylvestris*, Wild Teasel; leaves opposite, serrated, chaff straight, involucrum bent inwards, and longer than the head; a smaller plant than the preceding; biennial; flowers in July, and grows in moist hedges and way-sides in England.

Scabiosa. *Gen. char.*—Common cal. many-leaved; proper, superior, double; receptacle chaffy, or naked.

Scab. *Succisa*, Devils-bit Scabious; florets quadrifid, equal; stem-leaves toothed, flowers nearly globular. Perennial; flowers in August, and is common in pastures. The trivial name is derived from the truncated or bitten appearance of the root.

Scab. *Arvensis*, Field-scabious; small corollas four-cleft, radiating; leaves pinnatifid, deeply cut, stem hairy. Perennial; flowers in July; is common in fields and meadows, and is easily distinguished from the preceding, particularly by its long branches and spindle-shaped root. The flowers exposed to the fumes of tobacco assume a bright green colour. *Smith.*

Sherardia *Arvensis*; Little-field Madder. *Gen. char.*—Cor. monopetalous, funnel-shaped, superior; seeds two, three-toothed. *Spec. char.*—Leaves whorled, flowers terminal. This beautiful little plant is annual, flowers through the whole summer, and is not uncommon among corn and in uncultivated fields.

Asperula *Odorata*, Sweet Woodroof. *Gen. char.* Cor. one-petaled, funnel-shaped, superior; seeds two, round. *Spec. char.*—Eight lanceolated leaves in the whorl, fascicles of flowers on footstalks. Perennial; flowers in May, is common in shady woods, and is collected on account of its fragrance. When dried it gives out the odour of benzoin.

Galium. *Gen. char.*—Cor. one-petaled, plain, superior; seeds two, roundish.

Gal. *Verum*, Yellow Bed-Straw, or Cheese-Rennet; with eight leaves, linear, furrowed, entire, rough; flowers paniculated and crowded; perennial; flowers in July and August, and is very common on dry banks. It is easily known by its bright yellow flowers, which emit the smell of honey.

Gal. *Aparine*, Goose-grass, or Cleavers; with eight leaves, lanceolate, keeled, rough, reversely prickled; stem flaccid, seeds rough. An annual plant; flowers in May and August, and is very common in hedges, on which its weak trailing stems are supported.

Plantago. *Gen. char.*—Calyx four-cleft; cor. four-cleft, inferior, limb reflected, stamens very long, capsule two-celled, opening horizontally.

Plan. *Major*, Greater Plantain; with ovate smoothish leaves, shorter than the footstalk, scape or flower-stem round, spike imbricated with flowers, seeds very numerous; perennial; flowers through the summer, and is one of the most common plants in meadows, pastures, and by way-sides.

Plan. *Media*, Hoary Plantain; with ovate downy leaves, longer than the footstalk. Is perennial; flowers through the summer, but is less common than the other species, from which it is readily distinguished by its dense spike and purple stamens, furnished with white anthers. Roman camp, near Dalkeith in Scotland, and on the walls of Carlisle castle.

Plan. *Lanceolata*, Ribwort Plantain; with lanceolate leaves and angular flower-stem. Is perennial; flowers in June and July, and is very common in meadows and pastures. Two other species, Plan. *Maritima*, Sea Plantain, with linear leaves, on the sea-shores; and Plan. *Coronopus*, Buckshorn Plantain, with pinnatifid leaves, in dry sandy places near the shore,—are natives of Britain.

Alchemilla. *Gen. char.*—Cal. eight-cleft, with the alternate segments smaller, inferior; cor. none; one naked seed.

Al. *Vulgaris*, Common Lady's Mantle; with leaves folded, lobed; perennial; flowers in June and July, and is very common in meadows and elevated pastures.

Al. *Alpina*, Alpine Lady's Mantle; with leaves digitate, serrated, covered underneath with a white silky down; perennial; flowers in July, and is a native of the mountains of Scotland and the north of England.

Protea. *Gen. char.*—Four-petaled, the petals uniting in different ways; the anther inserted on the petal below the apex; one seed, superior, naked.

Prot. *Cynaroides*, Artichoke-flowered Protea, or Silver-tree; with roundish, smooth leaves, on footstalks. This plant is a native of the Cape, is a low shrub remarkable for the magnificence of its flowers, and is cultivated in green-houses in the vicinity of London. *Bot. Mag.* 770.

Prot. *Cordifolia*, Heart-leaved Protea; with heart-shaped leaves, is a dwarf species, but is remarkable for the bright red colour of the stalks, and the red cartilaginous margin of the leaves. *Bot. Mag.* 649.

Prot. *Lepidocarpon*, Black-flowered Protea; with solitary flowers; rays of the calyx strap-shaped; incurvated, and bearded; leaves lanceolate; is also a native of the Cape of Good Hope, and has been admitted into the green-houses of this country. *Bot. Mag.* 674.

The structure of the flowers in the genus Protea is extremely curious. A great number of florets is inclosed within a common calyx, which is formed of many imbricated leaves or scales, and all attached to a common receptacle; and some parts of the flower are covered with fine hairs or down, from which the name of Silver-tree is derived.

Banksia *Ericifolia*, Heath-leaved Banksia. *Gen. char.*—Amentum or catkin scaly; cor. four-petaled; anthers sessile, in a cavity of the segments; caps. two-valved; two-seeded. *Spec. char.*—Leaves approximate, acerose, smooth. Native of New Holland, but is an inmate of the greenhouse of this country. The generic name is intended to commemorate the first discovery of the plant by Sir Joseph Banks. Several other species have been added, and all natives of the same region. The length and undulating appearance of the style adds greatly to the beauty of the flower; and the stigma being retained within the corolla till the petals are fully expanded, exhibits the singular appearance of each flower being furnished with a loop. *Bot. Mag.* 738. See Plate 31. Fig. 4.

Order II. Digynia.

Buffonia *Tenuifolia*, Slender Buffonia. *Gen. char.*—Cal. four-leaved; cor. four-petaled; caps. one-celled; double seeded. An annual plant; flowers in June; but is rare in this country.

Order III. Tetragynia.

Ilex. *Gen. char.*—Cal. four or five-toothed; cor. wheel-shaped; no styles; some flowers are four-cleft, and have only stamens.

Il. *Aquifolium*, Holly-tree; with ovate, acute, spinous leaves; flowering in May, and common in hedges and woods. The holly is well known by its beautiful evergreen leaves and scarlet berries, which stand through the winter. The wood, which is susceptible of a fine polish, is employed by the cabinet-maker, and common birdlime is prepared from the bark.

Potamogeton. *Gen. char.*—Cal. none; petals four; no style; four seeds.

Pot. *Natans*, Broad-leaved Pondweed; with the upper leaves longish, ovate; foot-stalked; floating. Perennial; flowers in July, and is common in rivers and stagnant waters.

Pot. *Lucens*, Shining Pondweed; with ovate, lanceolate, plain leaves, diminishing into footstalks; perennial; flowers in June and July, and is frequent in ditches, rivers, and lakes. The flower-spike only of this plant appears above water.

Pot. *Pectinatum*, Fennel-leaved Pondweed; with setaceous, parallel, approaching leaves, set on two sides of the stem, and sheathing at the base; perennial; flowers in July, and not uncommon in rivers and pools, and is also met with in salt-water ditches.

Sagina. *Gen. char.*—Cal. four-leaved; petals four; caps. one-celled.

Sag. *Procumbens*, Procumbent Pearlwort; with procumbent, smooth stems, and very short petals; perennial; flowers from May to August, and is a common plant in sandy places, on walls, and in the neglected walks of gardens.

Sag. *Apetala*, Annual small-flowered Pearl-wort; with downy, somewhat erect stalks, and obsolete petals; annual; flowers in May and June, and is common on walls and sandy places.

Class V. Pentandria. Five Stamens.

This is a very large class, and is divided into six orders.

Order I. Monogynia. One Style.

Heliotropium. *Gen. char.*—Cor. salver-shaped, five-cleft, with teeth between; seeds four; throat closed with arches.

Hel. *Peruvianum*, Peruvian Turnsole; with lanceolate, ovate leaves, shrubby stem, and numerous aggregated corymbose spikes; native of Peru, as the name indicates, but seldom absent from the greenhouse or stove, on account of the delicious fragrance of its flowers.

Echium. *Gen. char.*—Cor. with a naked throat, irregular; stigma two-parted.

Ech. *Vulgare*, Common Viper's Bugloss; with a hairy, tuberculated stem; stem-leaves hairy, lanceolate; spikes lateral, deflected. Biennial; flowers in June and July, and is common in fields and waste places.

Ech. *Italicum*, White Viper's Bugloss; in which the stamens are very long. Is common on sandy grounds in the island of Jersey.

Lycopsis. *Gen. char.*—Cor. tube incurvated, closed with convex scales.

Lyc. *Arvensis*, Small Bugloss; with rough, lanceolate leaves; annual; flowers in June and July, and is very common in fields and by waysides, where it is easily recognised by its beautiful blue flowers, and the curved tube of the corolla.

Symphytum. *Gen. char.*—Cor. limb tubulated, ventricose; throat closed with awl-shaped rays; cal. five-parted.

Sym. *Officinale*, Comfrey; with leaves ovate, lanceolate, decurrent; perennial; flowers in May and June, and is not uncommon in moist and shady places.

Sym. *Asperrimum*, Prickly Comfrey; with prickly stalks; acute, ovate leaves on footstalks; floral leaves opposite; racemes double. This splendid species is a native of Caucasus, is a hardy perennial, rises to the height of five feet, and with its blue and red flowers is a fine ornament of the shrubbery. *Bot. Mag.* 927.

Borago. *Gen. char.*—Cor. wheel-shaped, throat closed with rays.

Bor. *Officinalis*, Common Borage; with all the leaves alternate; biennial; flowers in June and July, is a common plant in the garden, and is sometimes met with in waste places, and by way-sides.

Pulmonaria. *Gen. char.*—Cor. funnel-shaped, with an open throat; cal. prismatic, five-angled.

Pul. *Officinalis*, Common Lungwort; cal. of the same length as the tube; leaves ovate, rough; perennial; flowers in May, is common in gardens, and sometimes appears in woody places.

Pul. *Maritima*, Sea Bugloss, or Lungwort; cal. shortened; leaves ovate, azure-coloured; stem branching, procumbent. Perennial; flowers in July, and with its beautiful blue and red flowers, contrasted with elegant waved azure leaves, adorns the sandy shores of the western coasts of Scotland and north of England.

Myosotis *Scorpioides*, Mouse-ear Scorpion Grass. *Gen. char.*—Cor. salver-shaped, five-cleft, slightly notched, throat closed with arches.—*Spec. char.* Seeds naked, leaves elliptical-lanceolate; racemes many flowered, without bracteas. A very common plant, and greatly diversified in its habits and appearance, from soil and situation. In dry shady places it is rough and hairy, but on a wet soil it is quite smooth. Its beautiful blue flowers, which are of a fine flesh colour before expansion, cannot fail to excite admiration.

The plants now described, from the roughness of the leaves, belong to the natural order *asperifoliæ*, or rough-leaved plants; and on examination it will be found that a general uniformity of character in other respects prevails, and particularly in the evolution of the flower stem.

Primula. *Gen. char.*—Cap. one-celled, mouth ten-cleft; tube of the corolla cylindrical, stigma round.

Prim. *Vulgaris*, Common Primrose; with leaves toothed, wrinkled; scape or flower-stem one-flowered, limb of the corolla plain; perennial; is the well known harbinger of spring, and is very common in woods and hedges.

Prim. *Elatior*, Oxlip, or great Cowslip; with toothed and wrinkled leaves contracted in the middle, many flowered scape, limb of the corolla plain; perennial; flowers in April, and grows in pastures and among brushwood, but is not very common.

Prim. *Veris*, Common Cowslip, or Paigle; differs from the preceding by the limb of the corolla being concave; is also perennial; and is common in meadows and pastures in England.

Prim. *Farinosa*, Birds-eye Primrose; with smooth crenated leaves, dusty underneath; is also perennial; flowers in June and July, and with its elegant flowers adorns the mountainous pastures in the north of England, and grows plentifully in a meadow north from Stromness in Orkney.

All the varieties of polyanthus which have arisen from long and repeated culture, derive their origin from the species of primula now described; and from another species, *Primula Auricula*, all the beautiful varieties of the auricula which adorn the flower garden in the spring, have proceeded.

Soldanella *Alpina*, Alpine Soldanella. *Gen.*

Pentandria.

char.—Cor. bell-shaped, deeply divided, or fringed; caps. one-celled. Of this genus this beautiful species only is known; it is a native of the elevated regions of Switzerland and Germany; grows readily in this country, and expands its fine blue or white blossoms in March.

Dodecatheon *Meadia*, American Cowslip; is a native of Virginia, common in gardens, and is easily recognised by its wheel-shaped corolla, the segments of which are bent back.

Menyanthes. *Gen. char.*—Cor. villous; stigma bifid; caps. one-celled.

Men. *Trifoliata*, Marsh Trefoil, Buck-bean, or Bog-bean; with ternate leaves, upper surface of the corolla villous; perennial; flowers in June and July, and is very common in marshy places. The elegant flowers of this plant, which are of a pure white, or delicately tinged with pink, and beautifully fringed on the upper surface, will amply reward a minute examination.

Anagallis. *Gen. char.*—Cor. wheel-shaped, caps. divides horizontally, stamens furnished with jointed hairs.

An. *Arvensis*, Scarlet Pimpernel; leaves ovate, dotted on the lower surface; stem procumbent. Annual; flowers in June and July, and is common in corn fields and gardens. This beautiful little plant, varieties of which appear with blue and white flowers, will recommend itself to the attention of the botanist by the curious jointed structure of the hairs on the filaments, which may be seen by a hand magnifier, but more distinctly with a microscope of greater power, and also by its seed-vessel, which divides into hemispheres.

An. *Monelli*, with fine blue flowers; a native of Spain and Italy, has been long an inmate of the green-house; and *Fruticosa*, Shrubby Pimpernel, with large orange flowers, supposed to be a native of Africa, has been lately introduced.

Azalea. *Gen. char.*—Cor. bell-shaped, stamens attached to the receptacle, caps. five-celled.

Az. *Procumbens*, Trailing Azalea; with diffuse procumbent branches, and opposite, very smooth revolute leaves; is a native of the high mountains of Scotland.

Az. *Pontica*, Yellow Azalea; with lance-shaped, shining leaves; is a native of mount Caucasus, and the banks of the Dnieper, and is now cultivated in gardens; rises to the height of two or three feet, and produces umbels of fragrant flowers at the extremities of the branches.

Convolvulus. *Gen. char.*—Cor. bell-shaped, folded; stigmas two; caps. two or three-celled, with two seeds in each.

Con. *Arvensis*, Small Bindweed; with arrow-shaped leaves, acute on both sides; one-flowered peduncles, and minute bracteas remote from the flower. Perennial; flowers in June and July, and is a very common weed in fields and gardens.

Con. *Sepium*, Great Bindweed; with arrow-shaped leaves, and one-flowered angular peduncles; is perennial; grows in moist hedges, where it is readily distinguished by its large white or pinkish flowers.

Con. *Soldanella*, Sea Bindweed, with kidney-shaped leaves, and one-flowered peduncles; perennial; flowers in July, and is a native of particular spots on the sandy shores of the western parts of Scotland. Its specious reddish flowers are highly ornamental to the barren shores.

Pentandria.

Polemonium *Cæruleum*, Jacob's Ladder, or Greek Valerian. *Gen. char.*—Cor. five-parted, stamens inserted on scales shutting the base of the corolla; stigma three-cleft; caps. superior, three-celled. *Spec. char.*—Leaves pinnated, flowers erect, with the calyx longer than the tube of the corolla. This plant offers itself for examination in every garden, and varies with blue and white flowers.

Campanula. *Gen. char.*—Cor. bell-shaped, the bottom closed with valves supporting the stamens; stigma three-cleft; caps. inferior, opening by lateral pores.

Cam. *Rotundifolia*, Round-leaved Bell-flower; with radical leaves kidney-shaped, stem leaves linear; perennial; flowers in August and September, and is very common on heaths, walls, and about the borders of fields.

Cam. *Latifolia*, Giant Bell-flower; with ovate lanceolate leaves, very simple round stem, and one-flowered peduncles; perennial; flowers in August, and is not uncommon in woods and shady places, both on the east and west of Scotland.

Cam. *Speculum*, Venus' Looking-glass; with branched diffuse stem, oblong slightly crenated leaves, and solitary flowers; is a native of the south of Europe, and generally finds a place among the ornamental annuals of the garden, to which the brilliancy of its flowers justly recommends it.

Cinchona. *Gen. char.*—Cor. shaggy, stigma simple; caps. two-celled, opening within; seeds numerous.

Cin. *Officinalis*, and some other species of the same genus, which grow to the size of trees, furnish the pale, yellow, and red bark, which are so extensively employed in medicine. From the place of their growth it is called Peruvian Bark; and the generic name, *Cinchona*, is said to have been derived from the Countess del Cinchon, the lady of a Spanish viceroy, who was cured by its use about the year 1640; and being recommended by the Jesuits, it obtained the designation of Jesuits bark.

Cin. *Caribbea*, called in Jamaica, *Sea-side Beech*, is a tree which rises to the height of fifteen or twenty feet, and was brought into notice by Dr Wright, who found that it was not less efficacious in the cure of fevers than the Peruvian bark. Two other species have been discovered in Jamaica.

Coffea. *Gen. char*—Cor. salver-shaped, five-cleft; stigma two-parted; berry two-seeded.

Several species of this genus have been described. *Occidentalis* is a native of the West Indies; but *Coffea Arabica* or Coffee-tree, originally from Arabia as the name imports, is the cultivated species. The leaves are opposite, and many sessile flowers are produced at their insertion. The coffee tree naturally rises to the height of 17 or 18 feet; but when under culture it is kept at five or six feet, for the convenience of collecting the ripe berries. The trees are planted

Pentandria.

in regular rows; and when they are in full bloom nothing can exceed the beauty of their pure, white, clustered flowers, and the delicious perfume which they exhale; the air is filled with fragrance, and the trees seem as if covered with a shower of snow, affording a fine contrast to the dark green foliage. But this enchanting scene is of transient duration; the flowers decay a few hours after they are full blown, and all the beauty and fragrance which delighted the senses in the morning, have vanished before noon. The berries which succeed the flowers are first green, when fully grown become red, ripen into a dark purple, and at last shrivel and drop from the tree. The fruit is fit for collecting about seven months from the appearance of the flowers. The berries are either dried on platforms, or the pulp is bruised by means of a machine, or passed through the grating-mill, by which the pulp is torn off, and the seeds completely separated; they are then washed in water, dried in the sun or by means of artificial heat, and afterwards put up in bags for the market.

Viola. *Gen. char.*—Cor. five-petaled, irregular, horned behind; anthers united; caps. superior, three-valved, one-celled; cal. five-leaved, lengthened at the base.

V. *Odorata*, Sweet Violet; without stem, shoots creeping, leaves heart-shaped, with smoothish footstalks; perennial; flowers in March and April, and grows in woods and hedges. Cultivated in the garden for the sake of its fragrant flowers.

V. *Tricolor*, Pansy Violet, Heart's Ease; stem angular, leaves oblong, toothed, crenated, with lyre-shaped pinnatifid stipulæ; annual; flowers through the summer.

V. *Lutea*, Yellow Mountain Pansy; with triangular stem, and leaves ovate-oblong, crenated and ciliated; perennial; flowers through the summer, and is common in mountainous pastures in Scotland and the north of England.

Hyoscyamus *Niger*, Common Henbane. *Gen. char.*—Cor. funnel-shaped, obtuse, irregular; stamens inclined; caps. covered, two-celled. *Spec. char.* Leaves embracing the stem; flowers sessile. Annual; flowers in July, and is frequent in waste places about towns and villages. The calyx is finely reticulated, and the yellow corolla is beautifully marked with purple veins; but the whole plant is of a poisonous and narcotic quality.

Atropa *Belladonna*, Deadly Nightshade. *Gen. char.*—Cor. bell-shaped; stamens distant; berry superior, two-celled. *Spec. char.*—Stem herbaceous; leaves ovate, entire. Perennial; flowers in June, and grows in waste places, but rarely. We have only met with this plant, in Scotland, near the ruins of religious houses,—at Lincluden near Dumfries, and Kinloss Abbey in Morayshire, which has excited a conjecture that it may have been originally introduced. The berries are a deadly poison.

Solanum. *Gen. char.*—Cor. wheel-shaped; anthers slightly united, opening at the top by a double pore; berry superior, two-celled.

Sol. *Dulcamara*, Woody Nightshade, or Bitter-Sweet; with a shrubby, waving, unarmed stem, upper leaves halberd-shaped, racemes cymose; a shrubby plant; flowers in June and July; and is common in moist hedges, where it is conspicuous by its climbing stalks, purple flowers, and red berries.

Pentandria.

Sol. *Nigrum*, Common or Garden Nightshade; with herbaceous unarmed stem, and nodding lateral umbels; flowers through the summer, produces black berries, and grows in waste places. Both species are poisonous.

To this genus belongs the common potatoe, Solanum *Tuberosum*, the varieties of which, from culture and diversity of soil and situation, are almost endless. Its large flowers afford great facilities in examining the characters of the genus.

Lonicera. *Gen. char.*—Cor. monopetalous, irregular; berry many-seeded.

Lon. *Caprifolium*, Pale Perfoliate Honeysuckle; with flowers ringent, whorled, terminal; deciduous leaves; upper leaves perfoliate; shrubby; flowers in May and June, and grows in woody places.

Lon. *Periclymenum*, Common Honeysuckle, or Woodbine; with flowers in ovate, imbricated, terminal heads; all the leaves distinct and deciduous; shrubby; flowers in June and July, and is common in woods and hedges.

Ribes. *Gen. char.*—Cal. superior, bell-shaped, five-cleft; petals and stamens inserted in the calyx; style two-cleft; berry many-seeded.

Rib. *Rubrum*, Common Currants; unarmed; with smooth pendulous racemes; plain flowers; petals obcordate; flowers in May, and is a native of woods and banks of rivers in the north of England, and of the island of Isla in Scotland, but is well known as the red and white currants of the garden.

Rib. *Nigrum*, Black Currants; with racemes hairy, pendulous, and with a simple peduncle at the base; grows wild in some parts of England and in Isla, but, from being universally cultivated, is equally familiar.

Rib. *Grossularia*, Rough Gooseberry; with prickly branches; footstalks of the leaves hairy; peduncles one-flowered; fruit rough.

Rib. *Uva-Crispa*, Smooth Gooseberry; is reckoned a distinct species, but is scarcely different, except in the smoothness of the fruit. From these two species all the varieties of the gooseberry have been produced.

Hedera *Helix*, Common Ivy. *Gen. char.*—Cal. five-toothed; petals five, dilated at the base; berry five-seeded, surrounded by the calyx. *Spec. char.* Leaves ovate-lobed. This well known plant flowers in October, and affords a fine example of the *caulis radicans*, or rooting stem, which throws out fibres for its support, and attaches itself to walls or trees, as it creeps along. The leaves on the stem are five-lobed, but on the top of the branches they are ovate and undivided.

Order II. Digynia. With two Styles.

Ulmus. *Gen. char.*—Cal. five-cleft, inferior, permanent; cor. none; caps. membranaceous, compressed, one-seeded.

Ulm. *Campestris*, Common Elm; with leaves doubly serrated, rough, and unequal at the base; the flowers appear in April, and it is easily distinguished by the inequality of the leaves.

Ulm. *Montana*, Broad-leaved Elm, or Witch Hazel; is distinguished from the preceding by its broader, less rough, pointed leaves; flowers at the same time, and is common in woods and hedges.

Gentiana. *Gen. char.*—Cor. tubular at the base; destitute of nectariferous pores; caps. superior, one-celled, two-valved, many-seeded.

Gen. *Verna*, Spring Gentian; with five-cleft, salver-shaped, crenated corolla; segments with appendages at the base; leaves ovate, crowded together. Perennial; flowers in April, and is a native of the mountains in the north of England and in Ireland; but is an early and beautiful ornament of the garden.

Gen. *Campestris*, Field Gentian; with four-cleft, salver-shaped corolla; bearded at the throat; interior segments of the calyx very large. Annual; flowers in September; and grows in dry upland pastures, and in sandy downs near the sea.

Stapelia. *Gen. char.*—Cor. wheel-shaped, with a double star-like nectary covering the parts of fructification.

Stap. *Grandiflora*, Great Flowered Stapelia; with club-shaped, quadrangular branches; the angles toothed; the corolla large, five-cleft; segments lanceolate, acute, and ciliated on the margin. *Bot. Mag.* 585. See Plate 31. Fig. 6.

All the species of this singular tribe of plants are natives of the arid deserts in the vicinity of the Cape of Good Hope. They are remarkable for the succulence of their stems and branches, which enables them to exist in a parched soil. The Stapelia, from a mistaken analogy, has been denominated the camel of vegetables, because it retains a large portion of fluid in the midst of those burning sands, where scarcely any other plants appear; but the resemblance between the animal and the vegetable does not hold with regard to structure, although the stapelia, in some of its properties, approaches to the nature of animal matter. Stap. *asterias*, star-fish stapelia, exhales the odour of putrid fish; and insects, attracted by the smell, deposit their eggs in some of the species as on animal matter.

Umbellated Plants.

In their general habits and appearance these plants exhibit a striking resemblance, and are therefore associated in the same natural order. They are subdivided into three sections, as they are furnished with an involucrum or are destitute of that appendage.

A. With universal and partial involucrum.

Eryngium. *Gen. char.*—Involucrum many-leaved, flowers in heads; common receptacle, conical, chaffy.

Eryn. *Maritimum*, Sea-holly; with radical leaves, roundish, folded, and spinous flower-heads, with foot-stalks; perennial; flowers in July and August, and is common on sandy shores.

Eryn. *Campestre;* with leaves embracing the stem, somewhat pinnated, and deeply cut; is also perennial; flowers in July and August, and is found, but more rarely, in pastures near the sea.

Conium *Maculatum*, Common Hemlock. *Gen. char.*—The small involucrum extending half round, and about three-leaved; fruit ovate, with five ribs on each side; petals equal. *Spec. char.*—With seeds smooth and much branched, stem shining, spotted. Biennial; flowers in June and July, and is one of the most common plants among rubbish and in waste places.

Heracleum *Sphondylium*, Common Cow-parsnep. *Gen. char.*—Fruit elliptical, compressed, striated, dilated with a margin; flowers radiating; petals inflected, emarginate; involucrum not permanent. *Spec. char.*—Leaves pinnated, the leaflets pinnatifid, cut, and serrated. Biennial; flowers in July, and is very common in hedges, on the borders of fields, and in moist meadows, where it is readily recognized by its tall stem, which rises to the height of four feet, and large leaves.

Daucus *Carota*, Wild Carrot. *Gen. char.*—Involucrum pinnatifid, flowers nearly radiated, fruit muricated. *Spec. char.*—Seeds rough, foot stalks of the leaves nerved beneath. Biennial; flowers in June and July, and is common everywhere in pastures and on the borders of fields.

B. With partial involucrum, none universal.

Cicuta *Virosa*, Water Hemlock. *Gen. char.*—Fruit nearly ovate, furrowed; cor. regular. *Spec. char.* Umbels opposite to the leaves, with obtuse stipulæ attached to the foot-stalk. Perennial; flowers in August, and grows in ditches and on the banks of rivers; but as it is a very poisonous plant, it is fortunately not common. It grows sparingly at the edge of Lochend lake near Edinburgh, and on the borders of one of the lakes at Lochmaben in the south of Scotland.

Æthusa *Cynapium*, Fools Parsley, or Lesser Hemlock. *Gen. char.*—Fruit striated, small involucrum, three-leaved, pendulous. This species is easily distinguished by its round, slightly striated stem, and smooth, deep green, doublypinnated leaves. Annual; flowers in July and August, and is a common weed in gardens. It has been sometimes mistaken for parsley, to which it has some resemblance; but as it is of a noxious quality, it should be carefully avoided.

Scandix. *Gen. char.*—Flowers radiating, petals emarginate, seed awl-shaped, flowers of the disk often with stamens only.

Scan. *Odorata*, Sweet Cicely, Great Chervil, or Myrrh; with angular furrowed seeds; flowers in May, and is common in waste places, but is always near houses; supposed not to be indigenous.

Scan. *Pecten-Veneris*, Venus's Comb, or Shepherd's Needle; with seeds furnished with very long beaks; common in cultivated fields; annual; and flowers in June and July.

C. With no involucrum.

Pastinaca *Sativa*, Wild Parsnep. *Gen. char.*—Seed elliptical, compressed-plain; petals rolled inwards, entire. *Spec. char.*—Leaves simply pinnated, hoary on the lower surface. Biennial, and rises to the height of three feet; flowers in July, and not uncommon on the borders of fields.

Apium *Graveolens,* Smallage, or Wild Celery. *Gen.char.*—Seed ovate, ribbed; petals inflected, equal. *Spec. char.*—Leaflets of the stem wedge-shaped, stem furrowed. Biennial, and flowers in August; in ditches and marshes near the sea; is acrid and poisonous, but becomes esculent when cultivated.

Ægopodium *Podagraria,* Gout-weed. *Gen. char.* Seed ovate-oblong, ribbed; petals inflected, heart-shaped, unequal. A troublesome weed in cultivated grounds and waste shady places. Perennial, and flowers in May and June.

Order III. Trigynia.

Sambucus. *Gen. char.*—Cal. superior, five-parted; cor. five-cleft, berry three-seeded.

Sam. *Ebulus,* Dwarf Elder; with three-parted cymes, and herbaceous stem; perennial; flowers in July, and grows in waste places and hedges, but not very common. The stem, which rises to the height of three feet, dies away in the winter.

Sam. *Nigra,* Common Elder; with five-parted cymes and arborescent stem; flowers in June, and is very common in hedges and woods, where it is easily recognized by its white fragrant flowers, and dark purple or white berries.

Order IV. Tetragynia.

Parnassia *Palustris,* Grass of Parnassus. *Gen. char.*—Cal. five-parted, petals five; nectaries five, heart-shaped, ciliated with globular summits; caps. four-valved; perennial; flowers in September and October, and is frequent in marshy soils, where it is easily distinguished by its angular twisted stem, bearing one leaf and one beautiful snow-white terminal flower; but the curious and elegant structure of the nectaries will not fail to excite the attention and admiration of the botanist.

Order V. Pentagynia.

Statice. *Gen. char.*—Cal. one-leafed, entire, folded, withered; petals five; seed one, superior.

Stat. *Armeria,* Thrift, or Sea-gilliflower; with simple stem, flowers capitate, leaves linear; perennial; flowers in July and August, and is common on slimy shores, and in moist alpine regions.

Stat. *Limonium,* Sea-Lavender, with a round paniculated stem; perennial; flowers in July and August, and grows also on muddy shores, but is less common.

Linum. *Gen. char.*—Cal. five-leaved; petals five; caps. superior, ten-valved, ten-celled, seeds solitary.

Lin. *Usitatissimum,* Common Flax; with the leaves of the calyx ovate, acute, three-nerved, petals crenated, leaves lanceolate alternate; annual; flowers in July, and sometimes appears among corn, but is well known as the cultivated species of flax.

Lin. *Catharticum,* Purging Flax; with leaves opposite, stem divided above; petals acute; annual; flowers from June to August, and is not uncommon in dry elevated pastures.

Lin. *Arboreum,* Tree-Flax; with wedge-shaped leaves and arborescent stem; is a native of the Levant, but has been admitted to the green-house on account of its beautiful yellow flowers, which grow in succession throughout the summer.

Drosera. *Gen. char.*—Cal. five-cleft, petals five; caps. one-celled, three-valved, superior; many-seeded.

Dros. *Rotundifolia,* Round-leaved Sun-dew; with leaves round, radical, stem branched; perennial; flowers in July and August, and is not uncommon in boggy ground.

Dros. *Longifolia,* Long-leaved Sun-dew; with leaves radical, obovate; in similar places with the former, but less frequent.

Dros. *Anglica,* Great Sun-dew; has nearly the same characters as the preceding, but is furnished with eight styles and a four-valved capsule, is double the size, and a rarer plant.

The upper surface of the leaves of all these species of sun-dew is thinly set with long red hairs, which exude a transparent viscid fluid, especially during bright sunshine. Small insects, which are attracted to the leaves, or alight accidentally upon them, are entangled in the hairs, and destroyed by being enclosed in the leaves, which fold upon them in consequence of the irritation from the motions of the struggling insect.

Crassula. *Gen. char.*—Cal. five-leaved; five petals; and five nectariferous scales at the base of the germen.

Cras. *Coccinea,* Scarlet-flowered Crassula; with ovate, plain, cartilaginous-ciliated leaves, sheathing and united at the base. Native of the Cape, but a splendid inmate of the green-house, on account of the fragrance and rich scarlet of its flowers, which blow during the summer.—*Bot. Mag.* 495. Plate 31. Fig. 5.

The numerous species of crassula are remarkable for succulent leaves; they are chiefly natives of the Cape, and some of them shoot up to the size of small trees.

Order VI. Polygynia.

Myosurus *Minimus,* Mouse-tail. *Gen char.*—Cal. five leaved, with an appendage at the base; petals five, with a tubular nectariferous claw. An annual plant; flowers in May, and sometimes appears in fields of a gravelly soil.

Class VI. Hexandria.

Six Stamens; Six Orders.

Order I. Monogynia.

The genera arranged under this order are the most numerous of the class; they are divided into six sections, and include the splendid liliaceous tribe, which Linnæus has distinguished by the pre-eminent designation of the nobles of the vegetable kingdom.

Bromelia. *Gen char.*—Cor. tripartite; cal. tripartite, superior; a berry.

Brom. *Penguin,* Penguin of Jamaica; with leaves ciliate, spiny, dagger-pointed; raceme terminal. This singular plant is common in the Savannahs, Hexandria.

and on the rocky hills of Jamaica, and is usually employed for making fences; for which purpose it is admirably suited, by its firm leaves, thickly set on the edges with strong bent spines.

Brom. *Ananas*, Pine-apple; with leaves ciliate, spiny, dagger-pointed, and comose or tufted spike. Numerous varieties of this most delicious fruit are cultivated in tropical regions; and, to bring it to any degree of perfection in this country, the powerful heat of the stove is necessary.

Brom. *Karatas*, Silk Grass; with leaves erect, and aggregate, sessile flowers; native of Jamaica. The leaves of this plant grow to the height of five or six feet; and, when the outer rind is scraped off, the silky fibres are soaked in water, afterwards dried in the sun, and then manufactured into ropes and fishing-nets.

Galanthus *Nivalis*, Snowdrop. Cor. superior, six-petaled, the three interior petals shorter, acutely notched; stigma simple. The early appearance of the snowdrop, with its delicate nodding flowers, in February and March, renders it a well known plant.

Narcissus. *Gen. char.*—Cor. superior, six petaled, equal; nectary funnel-shaped, one-leafed, petaliferous; the stamens within the nectary; stigma three-parted.

Nar. *Poeticus*. Common Narcissus; with one-flowered sheath, nectary wheel-shaped, very short membranaceous notched leaves, obtusely keeled, reflected on the margin; said to be a native of some parts of England, but finds a place in every garden, and often varies with double flowers.

Nar. *Pseudo-Narcissus*, Common Daffodil; with one-flowered sheath, and erect bell-shaped nectary, equal in length to the ovate petals; perennial; flowers in March and April; not unfrequent in woods, common in gardens, and varies with double flowers.

Nar. *Jonquilla*, Common Jonquil, a native of Spain, Nar. *Tazetta*, Polyanthus Narcissus, a native of Spain, Portugal, and of the Barbary coast, Nar. *Orientalis*, with its numerous varieties, and other species of this beautiful genus, have been introduced among the ornaments of the flower-garden.

Amaryllis. *Gen. char.*—Cor. six-petaled, irregular; filaments inserted in the throat of the tube, declining, unequal.

Am. *Belladonna*, Belladonna Lily; with many flowered sheath; cor. bell-shaped, equal; supposed to be a native of South America, as it was introduced from Portugal, is frequently cultivated in gardens on account of the beauty and fragrance of its flowers.

Am. *Sarniensis*, Guernsey Lily; with plain linear petals, and the stamens and pistil upright and longer than the corolla; a native of Japan, but is cultivated in the open ground in the island of Guernsey, to which it was introduced by the melancholy accident of the shipwreck of a Dutch or English ship, with some of the roots on board from Japan, before the middle of the 17th century. The roots were cast ashore, buried in the sand, and after a few years, to the surprise and admiration of the inhabitants, exhibited their splendid flowers in all their pomp and beauty. Various other species of Amaryllis have been since introduced, all which are remarkable for their beauty and grandeur; but among them Am. *Vittata*, or Superb Amaryllis, which shoots up its stem to the height of three feet, shines conspicuous.—*Bot. Mag.* 129.

Hexandria.

Allium. *Gen. char.*—Cor. inferior, six-petaled, spreading; spathe two-cleft, many flowered; umbel crowded, stigma simple.

Al. *Ursinum*, Broad-leaved Garlic or Ramsons; with a naked semi-cylindrical stem, and lanceolate leaves on foot-stalks; perennial; flowers in May and June, and is common in woods and moist meadows.

Al. *Vineale*, Crow Garlic; with round-leafed bulbiferous stem, and stamens three-pointed; perennial; flowers in July, and is not uncommon in dry pastures and on old walls.

To the same genus belong Al. *Schœnoprasum*, or Chive Garlick, Al. *Porrum*, the garden leek, and Al. *Cepa*, the cultivated onion.

Agave *Americana*, American Aloe. Cor. superior, six-cleft, limb erect, shorter than the filaments; leaves somewhat compressed, dagger-shaped, spinous, toothed on the edges. This splendid plant is a native of the rocky hills of Jamaica; it is several years before it throws up the flower stem, which, in a vigorous plant, rises to the height of eight or ten, and sometimes, it is said, twenty feet, adorned with a prodigious number of yellow flowers, which render it conspicuous at the distance of many miles. It appears to be viviparous in its native soil; it seldom flowers in the stove in this country; but it is a vulgar mistake that it puts forth its blossoms only once in a hundred years. This seems to depend on the management and state of the plant. Plate 31. Fig. 7.

Hyacinthus. *Gen. char.*—Cor. inferior, six-cleft, somewhat bell-shaped; stamens inserted in the tube.

Hyac. *Nonscriptus*, (*scilla nutans* of Smith,) Wild Hyacinth; with linear leaves, nodding spike, with the flowers reflected at the summit; perennial; flowers in May, and is very common in woods and hedges.

Hyac. *Orientalis*, Garden Hyacinth, with many flowered raceme. This fine ornament of the garden and the parlour is a native of the vicinity of Aleppo and Bagdad, and of the coast of Barbary. It was cultivated in England about the end of the 16th century; and its numerous varieties, with white, red, blue, yellow, double, and semidouble flowers, have been objects of great attention among the Dutch florists. A single root of a rare variety has brought from L.100 to L.200 Sterling. Two thousand varieties are enumerated and named by the Harlem gardeners; and whole acres in the vicinity of that city are occupied in the cultivation of those flowers.

Lilium. *Gen. char.*—Cor. six-petaled, bell-shaped, with a longitudinal nectariferous line, petals channelled at the base.

Lil. *Candidum*, White Lily; with leaves sparse or scattered, bell-shaped corolla, smooth within; supposed to be a native of the Levant, or of Palestine, and is now a very common but splendid ornament of almost every garden, where it varies with double flowers, spotted with purple, and leaves striped or edged with yellow.

Lil. *Bulbiferum*, Orange Lily; with scattered leaves, erect, bell-shaped corolla, rough within. Native of Austria and Italy, but now one of the most common garden flowers.

Lil. *Chalcedonicum*, Chalcedonian Lily, or Scarlet Martagon; with lanceolate scattered leaves, flowers reflected, corolla bent back. Native of Persia, and common in gardens.

Various other species of lily are cultivated, among which *Lilium Martagon*, Turks' cap Lily, and *Lilium Superbum*, Superb Lily, the former a native of Germany and the latter of Carolina, are stately and magnificent plants.

Tulipa. *Gen. char.*—Cor. six-petaled, bell-shaped, inferior, no style; caps. three-celled.

Tul. *Sylvestris*, Wild Tulip; with a single, slightly nodding flower, and lanceolate leaves. Native of several parts of England; perennial, and flowers in April.

Tul. *Suaveolens*, Early dwarf Tulip; with lanceolate glaucous leaves, nearly equal in height to the one-flowered stem. This beautiful little tulip is supposed to be a native of the south of Europe, is well known under the name of *Duc Van Thol*, and is deservedly admired on account of its rich colours and sweet scent.

Tul. *Gesneriana*, which in its specific name commemorates Conrad Gesner, a botanist of the 16th century, and a systematic writer on the classification of plants, is a native of Turkey, and is the parent of all those rich varieties, amounting now to not fewer than a thousand, which command so much of the florist's care and admiration; Tul. *Breyniana*, a native of the Cape, with stem supporting from two to six flowers, is yet rare in the gardens of this country.

Berberis, *Vulgaris*, Barberry. *Gen. char.*—Cal. six-leaved, petals six, with two glands at the claws; no style; berry superior, two-seeded; a shrubby plant; flowers in May and June, and is common in hedges and among brushwood. The irritability of the stamens of the barberry is very remarkable.

Order II. Digynia.

Oryza *Sativa*, Rice. Cal. one-flowered, glume two-valved; Cor. two-valved; one oblong seed.—One species only of this valuable plant is known; the stem rises to the height of four or five feet, and the flowers are arranged on a terminating panicle. Rice is most successfully raised in those situations which admit of flooding with water; it is extensively cultivated in China and India, where it forms the chief food of the native inhabitants, as well as in Carolina, from all of which places it is imported into Europe, and forms a wholesome, nutritious aliment.

Order III. Trigynia.

Rumex. *Gen. char.*—Cal. three-leaved; petals three, meeting together; one triangular, superior, naked seed; stigmas much divided.

Rum. *Crispus*, Curled Dock; with all the valves ovate, entire; leaves lanceolate, waved, acute. Perennial; flowers in June and July, and is very common in waste places and by way-sides.

Rum. *Obtusifolius*, Broad-leaved Dock; radical leaves, heart-shaped, blunt; stem roughish. Common.

Rum. *Digynus*, Mountain Sorrel; the leaves radical, kidney-shaped, and on foot-stalks. Common on the mountains of Wales and Scotland, and sometimes used as salad.

Rum. *Acetosa*, Common Sorrel; with diœcious flowers, and oblong arrow-headed leaves; common in meadows and pastures.

Rum. *Acetosella*, Sheep's Sorrel; with diœcious flowers, and lanceolate halberd-shaped leaves; very common in barren pastures.

Order IV. Tetragynia.

Petiveria *Alliacea*, Guinea Henweed. Cal. four-leaved, no corolla; style lateral; one seed. This plant is a native of Jamaica and South America, is remarkably acrid, and, when chewed, produces great heat in the mouth; the Guinea hen is extremely fond of it, from which it derives its name; and it communicates the taste of garlic to the milk, and an unpleasant flavour even to the flesh of cattle that feed upon it. The Peruvians employed it as a charm, and fancied that its effects were very powerful and extensive; but its use was prohibited by the Spaniards, either from a desire to discourage such superstitions, or from an apprehension that they were injurious to their power.

Order V. Polygynia.

Alisma. *Gen. char.*—Cal. three-leaved; petals three; several seed-vessels.

Al. *Plantago*, Great Water Plantain; with acute ovate leaves, and bluntly-triangular capsules; common on the banks of lakes and rivers.

Al. *Ranunculoides*, Small Water Plantain; with linear lanceolate leaves, and incurvated five-angled capsules. In similar places with the preceding, but less common.

Class VII. Heptandria.

With Seven Stamens, and divided into Four Orders.

Order I. Monogynia.

Trientalis *Europæa*, Chickweed Wintergreen. Cal. seven-leaved; cor. seven-cleft, equal, plain; a dry berry. Common in woods on the sides of mountains in the north of England and in Scotland.

Disandra *Prostrata*, Trailing Disandra. Cal. five or seven parted; cor. wheel-shaped, five or seven parted; caps. two-celled, many-seeded. Native of Madeira, but not uncommon in the greenhouse and parlour, where its trailing stems, peltate leaves, and yellow flowers, render it an agreeable object. It is sometimes called by mistake a geranium. Plate 31. Fig. 8.

Æsculus *Hippocastanum*, Horse-Chesnut. Cal. five-toothed; cor. five-petaled, unequal; caps. three-celled. The horse-chesnut, which recommends itself to attention as a fine spreading tree, with large digitated leaves, and beautiful spikes of flowers, is a good example of this class and order, although the irregularity of the corolla may produce some difficulty to the young botanist.

To the second order, Digynia, belongs *Limeum*, an African genus of plants: Under the third, Tetragynia, is included *Saururus*, or Lizard's Tail, a native of Virginia: And the fourth order, Heptagynia, has only one genus, *Septas*, and one species. It is a native of the Cape of Good Hope, and is nearly allied to the genus *Crassula;* but it is remarkable in having seven segments in the calyx, seven petals, and seven germens.

Class VIII. Octandria.

Eight Stamens, and divided into Four Orders.

Order I. Monogynia.

Tropæolum *Majus*, Greater Indian Cress. *Gen. char.*—Cal. one-leafed, with a spur; petals five, unequal; berries three, dry; leaves peltate, five-lobed. Native of Peru, introduced about the end of the 17th century, and now one of the most common, although not the least splendid ornaments of the flower-garden, where it sometimes varies in colour, and with double flowers.

Epilobium. *Gen. char.*—Cal. four-cleft; petals four; caps. oblong, inferior; seeds downy.

Ep. *Angustifolium*, Rosebay Willow-herb, or French Willow; with scattered linear lanceolate leaves, unequal flowers, and declining stamens. Native of Britain, and common in gardens and shrubberies.

Ep. *Hirsutum*, Great Hairy Willow-herb, or Codlins and Cream; with leaves half embracing, ovate, lanceolate; stem much branched. Common in moist and shady places, as in the ditches round Edinburgh.

Ep. *Tetragonum*, Square-stalked Willow-herb; with lanceolate toothed leaves, and square stem. On the sides of ditches, and in marshy places.

Oenothera. *Gen. char.*—Cal. four-cleft; petals four; caps. cylindrical, inferior; seeds naked.

Oen. *Pumila*, Dwarf Oenothera, or Tree Primrose; with lanceolate, obtuse, and smooth leaves. Native of North America, and the smallest of this tribe of plants; is a hardy perennial, and continues to blossom through the summer.

Oen. *Longiflora*, Long-flowered Tree Primrose; with toothed leaves, simple hairy stem, and two-lobed petals. Native of Buenos Ayres, and rising to more than five feet in height; forms a fine ornament to an open border, where it flowers from July to October. *Bot. Mag.* 365.

Oen. *Biennis*, Biennial Tree Primrose; has been long an inhabitant of the garden, and possesses the remarkable peculiarity, as well as the preceding, and some other species, of expanding its flowers only in the night, contrary to the ordinary habits of plants in general.

Fuchsia *Coccinea*, Scarlet Fuchsia. *Gen. char.* Cal. one-leafed, coloured, very large; petals four; berry inferior, four-celled, many seeded. *Spec. char.*—Leaves opposite, ovate, toothed; obovate obtuse petals. Native of Chili; and although now one of the most common ornaments of the greenhouse and parlour, still recommends itself by the beauty of its rich, pendulous blossoms; the calyx and stamens are of a fine scarlet; and the corolla, as if apprehensive that exposure to light would injure its deep purple colour, is folded up within the cap. This fine plant is of humble growth, as it has been hitherto treated in this country; but in its native soil it probably attains a considerable magnitude; and in the splendid conservatory of Sir Robert Liston at Millburn Tower, near Edinburgh, it has reached the height of more than eight feet, and exhibits the gayest profusion of flowers and shining black berries. The scarlet fuchsia, planted in a sheltered border, survives the winter; the stems decay, but shoot up vigorously in the spring, and are clothed with flowers during the summer. Plate 32. Fig. 8.

Erica. *Gen. char.*—Cal. four-leaved; cor. four-cleft; stamens inserted in the receptacle; caps. superior, four-celled, many-seeded.

Er. *Vulgaris*, Common Heath or Ling; with anthers included, bearded style protruded; cor. four-parted, shorter than the calyx, with leaves opposite. Very common in moorlands and woods.

Er. *Tetralix*, Cross-leaved Heath; with four ciliated leaves in the whorl; flowers capitate. In moist moorlands.

Er. *Cinerea*, Fine-leaved Heath; with ternate leaves; also common in moorlands.

The three species now described are natives of every part of Britain.

Er. *Vagans*, Cornish Heath, is common in Cornwall; and *Er. Dabœcii*, Irish Heath, is a native of Ireland. But of this beautiful tribe of plants, nearly 300 species, chiefly natives of the Cape of Good Hope, and many of them pre-eminent for the elegance of their form, and the beauty of their flowers, are cultivated in this country.

Daphne. *Gen. char.*—Cal. four-cleft, having the appearance of a corolla inclosing the stamen; berry one-seeded.

Daph. *Mezereum*, Mezereon, or Spurge Olive; with sessile, ternate flowers on the stem; leaves lanceolate, deciduous. In woods in England, and common in gardens, where it is well known by the expansion of its fine red flowers before the leaves.

Daph. *Laghetto*, Lace-bark Tree; is a native of Jamaica, and grows to the height of 20 feet on rocky hills; but it is remarkable for the thickness of its bark, which is divisible into 20 or 30 thin layers as fine and white as gauze or lace, from which it has derived its name. Caps and ruffles, it is said, have been made of it; and a governor of Jamaica presented Charles II. with a cravat of the bark of this tree.

Order II. Digynia.

Moehringia *Muscosa*, Mountain Chickweed.—Cal. four-leaved; cor. four-petaled; caps. one-celled. Native of Germany, but not uncommon in gardens, where it sometimes has the common name

Octandria.

of Moss-plant, from the leaves forming a close turf like some mosses.

Order III. Trigynia.

Paullinia *Curassavica*, Supple Jack. Cal. four-leaved; cor. four-petaled; caps. three-celled, one-seeded; leaves biternate; the foot-stalks margined, and branches unarmed. Common in the woods of Jamaica, and rises to a great height, with its slender, woody, and flexible stems on the neighbouring trees. Deprived of its bark, it is well known in this country by the use of the smaller twigs, as riding-switches, and the larger pieces as walking-sticks.

Coccoloba *Uvifera*, Sea-side Grape. Cal. five-parted; cor. none; berry cup-like, one-seeded; leaves round, smooth. Common on the sandy shores of Jamaica, grows to a considerable magnitude, and the berries, about the size of the common grape, are sometimes eaten. Another species, Coc. *Pubescens*, is also a native of Jamaica, is sometimes seen in the stove in this country, and is remarkable for its large downy leaves.

Polygonum. Cal. five-parted, coloured, in place of a corolla, persistent; seed one, superior, angular, covered with the calyx; the stamens and pistils varying in number.

Pol. *Amphibium*, Amphibious Persicaria; with flowers of five stamens and two pistils, spike ovate. Not uncommon in ditches and pools, where it may be readily distinguished by its floating leaves and elegant flower-spike.

Pol. *Persicaria*, Spotted Persicaria; flowers with six stamens, and ovate oblong spikes. Common in ditches and moist places.

Pol. *Bistorta*, Great Bistort, or Snake-weed; with a simple leafy stem, and ovate waved leaves. In meadows and pastures, and common in gardens.

Pol. *Aviculare*, Knot-Grass; with axillary flowers, elliptical lance-shaped leaves, rough on the margin, and herbaceous procumbent stem; in waste places, and by way-sides, very common. The number of stamens, eight, and pistils, three, is complete in this species.

Order IV. Tetragynia.

Paris *Quadrifolia*, Herb Paris, or True Love. Cal. four-leaved; petals four, narrower; berry superior, four-celled; anthers attached to the middle of the filaments. Perennial; flowers in May; grows in shady woods, but is a very rare plant. No habitat is specified in the Flora Britannica, and we have met with it only in two places in Scotland, in the woods on the banks of the Cart, a little above Cathcart castle, near Glasgow, and in a shady wood on the banks of the same river, not far from the bridge on the road from Hawkhead, the seat of the Earl of Glasgow, to the old castle of Crookstone near Paisley.

Adoxa *Moschatellina*, Tuberous Moschatel. Cal. two or three-cleft; cor. four or five-cleft, superior; caps. four or five-celled. A small perennial plant; common in woods and shady hedges, and flowers early in spring.

Enneandria.

Class IX. Enneandria.

Nine Stamens; Three Orders.

Order I. Monogynia.

Laurus. *Gen. char.*—Cal. none; cor. six petaled, in the form of a calyx; berry one-seeded; glands of the nectary furnished with two bristles.

Under this genus are arranged many valuable plants, natives of different regions, among which are enumerated,

Laur. *Nobilis*, or Bay Tree, with spear-shaped, nerved, stiff leaves; a native of Italy, and deservedly admired on account of its evergreen foliage and fine red berries.

Laur. *Cassia*, the Cassia Tree; a native of the East; of which both buds and bark, having the properties of cinnamon, are employed as a spice, and for medical purposes.

Laur. *Chloroxylon*, Green Heart, or Cogwood Tree of Jamaica, with three-nerved, ovate, coriaceous leaves; a native of the mountainous parts of that island, and affording a strong durable wood, which is employed in machinery.

Laur. *Cinnamomum*, Cinnamon Tree; with ovate, oblong, three-nerved leaves. This precious tree, the bark of which yields the well-known and universally esteemed spice, is a native of Ceylon, and rises to the height of twenty or thirty feet. The cinnamon is obtained from the inner bark of the tree, and the strongest and best kind is got from the small branches, which do not exceed an inch in diameter. The leaves and other parts of the tree yield the same delicate flavour as the bark, and may be employed for similar purposes.

In Ceylon the cinnamon trees are barked twice in the year; the first, or great harvest, continues from April to August, and the second, or small harvest, from November to January. Branches of three years old are lopped off; and the epidermis, or outer bark, being removed by scraping with a knife, the twigs are ripped up lengthwise, and the bark is gradually loosened till it slips off. Smaller tubes or quills of peeled bark are inserted into those of larger diameter, which, as they dry, roll up closer together. They are afterwards tied up in bundles, and are ready for the market.

The Dutch long monopolized the trade of cinnamon. The first introduction of this plant into a British colony was in 1782, when some cinnamon trees were found in a collection of East India plants in a French ship from the Isle of France to St Domingo, which was captured by admiral Rodney. The collection was carried to Jamaica, and one of the cinnamon trees was planted in Mr East's noble garden in Liguanea, and another in the botanic garden at Bath. From them many hundreds of young trees, which now thrive in almost every part of the island, were produced; and it is gratifying to learn that they yield bark of the very finest quality.

Laur. *Camphora*, Camphor Tree; with lanceolate, ovate, triple-nerved leaves, the nerves extending to the point of the leaf. The camphor tree is a native of Japan, and grows to a large size, but is not a stranger to the green-house in this country. A fine specimen of this tree has been long an inhabitant of the botanic garden at Edinburgh; and this, as well as the sassafras tree, another species of the same genus, are among the fine collection in Sir Robert Liston's conservatory.

Every part of the tree yields camphor. The root, trunk, and branches, are cut into small pieces, and introduced into a still with water. The head of the still is lined with straw, and heat being applied, the water is kept boiling for two days, during which the camphor rises and attaches itself to the straw. In this state it is called crude camphor, which was formerly imported, and farther purified, by the Dutch.

Laur. *Persea*, Avocado, or Alligator Pear; with ovate, coriaceous, transversely veined leaves; said to be a native of South America, but very generally cultivated in the West Indies. The pulpy fruit of this tree is the celebrated *vegetable marrow*, a soft substance, of a consistence between butter and marrow, and is a mild nutritious food, agreeable to most palates, and greedily sought after by almost all animals. The eatable part is included between a thick rind and a large hard seed. It is commonly eaten with pepper and salt; and sometimes wine, sugar, or lime-juice, is added.

Anacardium *Occidentale*, Cashew-nut Tree. Cal. five-parted; a tenth stamen is without an anther; seed, a nut attached to a fleshy receptacle. This tree grows in a spreading form to the height of 20 feet; the cashew apple, which is reddish, or yellow, or streaked, is about the size and form of a French pippin, and is full of acid juice, which is employed as an ingredient in punch. The nut grows attached to the end of the fruit, and its covering contains a very acrid oil, which produces blisters on the skin, and is sometimes employed as a caustic.

Order II. Trigynia.

Rheum *Palmatum*, Rhubarb. Cal. none; cor. six-cleft; one triangular seed. This species, which has large palmated leaves, is a native of China, and yields the true rhubarb of the shops; although it is probable that the roots of more than one species are brought into commerce. The cultivation of this species has succeeded well in different parts of Britain; and the roots are considered by many to possess medical virtues equal to the imported rhubarb. Several other species of rhubarb are known; and of the stems of *rheum rhaponticum*, which sometimes is called English, and sometimes Scotch Rhubarb, an excellent tart is made.

Order III. Hexagynia.

Butomus *Umbellatus*, Flowering Rush. Cal. none; petals six; caps. six, superior; many-seeded. This plant, which is the only species of the order and genus, is a fine ornament to the banks of rivers and pools in England, where it is a native.

Class X. Decandria.

Ten Stamens; Five Orders.

Order I. Monogynia.

Sophora. *Gen. char.*—Cal. five-toothed, gibbous above; cor. papilionaceous, with wings the length of the vexillum.

Soph. *Tetraptera*, Winged-podded Sophora; with pinnated leaves, and pods furnished with four membranaceous wings. Native of New Zealand, where it was discovered by Sir Joseph Banks, and cultivated in green-houses in this country; in Chelsea gardens it has produced a magnificent profusion of pendulous yellow flowers, remarkable for the richness and brilliancy of their colouring.—*Bot. Mag.* 167.

Soph. *Monosperma*, Red Bead-tree; with leaves unequally pinnated, leaflets five-paired; pod one-seeded. Native of Jamaica and of the other West India islands; rises 10 feet high, and produces beautiful round scarlet seeds, marked with a black spot, which are brought to this country and employed for ornamental purposes.

Cæsalpinia. *Gen. char.*—Cal. with unequal segments; cor. with five petals, the lowest the largest.

Cæs. *Braziletto*, Brazil Wood; with leaves much divided, leaflets oval. Native of Jamaica and Brazil, produces a fine pyramidal spike of white flowers, beautifully variegated with red; is a strong durable wood, susceptible of a good polish, and affords the famous Braziletto wood, extensively employed in dyeing.

Hæmatoxylon *Campeachianum*, Logwood, or Campeachy-wood; stigma of the pistil notched at the summit, pod with boat-shaped valves. Native of the bay of Campeachy, from which the specific name is derived; it rises to the height of 16 or 20 feet, and is furnished with pinnated leaves, each having four pairs of small leaflets; has been introduced into Jamaica, where it grows luxuriantly, and is employed as a fence against cattle; but the wood of this tree is better known as it is imported into Europe for the purpose of a dye-stuff.

Swietenia. *Gen. char.*—Nectary tubular, ten-toothed; caps. noody, five-valved; seeds imbricated, with a membranous border.

Swiet. *Mahagoni*, Mahogany Tree; with pinnated leaves, four-paired, panicle axillary. Native of Jamaica, Cuba, and the Spanish Main; becomes a magnificent tree, and has been long celebrated as a commercial commodity, and for its extensive use in cabinet-work; it thrives well in almost every soil, but the wood of the closest texture, and most beautifully veined, is obtained from trees which grow on rocky ground.

The mahogany tree has been met with in Jamaica more than 100 feet in height; and one which was cut down in the parish of St Elizabeth measured 12 feet in diameter; it produced nearly L.400 Sterling to the proprietor, but it must be observed that this

Decandria.

happened in the time of the American war, when the price was high. Mahogany is now scarce in Jamaica, and is rarely met with, excepting in mountainous situations, from which it is with difficulty brought to convenient shipping-places for the market.

The introduction of mahogany into England took place about the commencement of the 18th century, and its first application was to the ignoble purpose of a candle-box. A Captain Gibbons, in the West India trade, brought home some planks of it as ballast, and presented them to his brother, a physician in London, who was then building a house, but the wood being found too hard for the tools of the carpenters, was laid aside as useless. Mrs Gibbons, desirous that the wood might not be lost, employed Mr Wollaston, cabinet-maker, to make a candle-box; he executed the task, but complained also of the hardness of the wood. Dr Gibbons then proposed to have a bureau made of the same wood; its agreeable colour and fine polish were universally admired; and, among the rest of his friends who crowded to see it, the Duchess of Buckingham was so delighted with its beauty, that she requested as much wood as would furnish her with a similar piece of furniture; the same cabinet-maker was employed; the fame of mahogany and Mr Wollaston spread far and wide, and the use of this wood soon became general.

The bark of the mahogany tree, as Dr Wright observes, resembles Peruvian bark in colour as well as in taste, but has more bitterness; and it has been employed as a substitute, in the form of powder, of infusion, and of tincture. The bark of another species, *Swietenia Febrifuga*, discovered by Dr Roxburgh in India, possesses similar properties, and has been used for similar purposes.

Guaiacum *Officinale*, Lignumvitæ. Cal. with the two outer segments smaller; caps. fleshy, three or four-celled; leaves angular, pinnated, with two pairs of obtuse leaflets. Native of the south side of Jamaica, to which it is chiefly confined, and rising to the height of forty feet. The wood is solid and ponderous, and affords a fine example of the difference between perfect wood and the alburnum, the former of which is of a yellowish colour, and the latter dark brown. It is extensively employed in machinery and turnery-work; and the gum-resin which exudes from the wounded tree is much used in medicine.

Ruta *Graveolens*, Common Rue. Germen with ten honey-bearing points; caps. five-cleft, five-celled and many-seeded, with supra-decompound leaves; leaflets wedge-shaped. Native of the south of Europe, but common in gardens, and once in great estimation on account of its medical virtues.

Quassia. *Gen. char.*—Cal. five-leaved, petals five, nectary five-leaved; caps. five, two-valved, one-seeded.

Quas. *Amara*, Bitter Quassia; flowers with both stamens and pistils, and leaves pinnated, with an odd leaflet. Native of Surinam, and, with its fine scarlet flowers, is a great ornament to the stove, where it blossoms freely. Three other species, *simaruba*, *excelsa*, and *polygama*, are natives of Jamaica; and from the bark of the roots a very strong bitter, which has been employed in medicine, and as a substitute for hops, is obtained.

Dionaea *Muscipula*, Venus Fly-trap. Cal. five-leaved, petals five, caps. one-celled, and many-seeded. Native of marshy places in South Carolina. The leaves of this singular plant are all radical, and supported on long, winged, succulent, and strongly veined foot-stalks; the leaf itself is composed of two semi-oval lobes, jointed at the back, which permits them to fold together. The sides of the lobes are furnished with a row of cartilaginous ciliæ, which lock into each other when the lobes close. Three very small spines, or bristles, rise in the middle of each lobe in some plants, but in others only two are observed. These spines are the only irritable points of the leaf; every other part may be touched with the point of a needle without the least motion being produced; but the moment it comes in contact with any of the spines the lobes fold together; and, in some experiments which we had lately an opportunity of making on a fine vigorous plant, it seemed that the motion was first communicated to the opposite lobe. The irritability of the spines was first discovered by Mr Edwards, natural history painter, and about the same time by Mr Koenig.

This curious plant thrives well in pots with bog-earth mixed with white sand, and the pot being kept in a pan of water in an airy stove; but it has been known even to succeed better when covered with a glass cylinder, open at top, and placed in the window of a room with a warm aspect. *Bot. Mag.* 785. Plate 32. Fig. 2.

Melastoma. *Gen. char.*—Cal. five-cleft, bell-shaped; petals five, inserted on the calyx; berry five-celled, covered by the calyx.

Mel. *Tomentosa*, Woolly Melastoma, or Indian Currant-Bush; with large subsessile oval leaves, woolly on the under side. Native of Guiana. Plate 32. Fig. 3.

Mel. *Corymbosa*; a native of Africa, is figured in *Bot. Mag.* 904; not fewer than thirty-two species are natives of Jamaica; and sixty species are described, with beautifully coloured figures, in the *Monograph* of this genus by Bonpland, the enterprising companion of Humboldt in his travels in South America, one of the most splendid botanical works which has yet appeared.

The number of stamens varies in the different species from eight to ten; and the nerved structure of the leaves in all the species gives them a striking and very natural character.

Andromeda. *Gen. char.*—Cal. five-parted; cor. ovate, with mouth five-cleft; caps. superior, five-celled.

And. *Polifolia*, Marsh Andromeda, or Wild Rosemary; with aggregated terminal peduncles, and alternate, lanceolate, revolute leaves, glaucous on the lower surface; on peat-bogs in the north of England and south of Scotland.

And. *Arborea*, Tree Andromeda, or Sorrel-Tree; with terminal panicles, the corolla somewhat downy, and elliptical, sharp-pointed, toothed leaves. Native of the Alleghany mountains, in North America, where it is said to grow to the height of fifty or sixty feet; but in the vicinity of London it becomes only a large shrub, with pendulous branches, terminated by long racemes of white flowers. *Bot. Mag.* 905.

Rhododendron. *Gen. char.*—Cal. five-parted; cor. funnel-shaped; stamens bent downwards; caps. five-celled.

Rhod. *Ponticum*, Purple Rhododendron; with shining lanceolate leaves, smooth on both surfaces, and terminal racemes. Native of Gibraltar, and of the south side of Mount Caucasus, but is familiar to the gardens of this country.

Rhod. *Maximum*, Laurel-leaved Rhododendron; with oblong leaves, smooth and discoloured underneath, with an acute reflected margin. Native of North America, where it grows to the height of sixteen feet, and has been introduced into the gardens of this country. *Bot. Mag.* 951.

Kalmia. *Gen. char.*—Cal. five-parted; cor. salver-shaped, with the limb five-horned beneath; caps. five-celled.

Kal. *Latifolia*, Broad-leaved Kalmia; with ovate, elliptical, ternate, and scattered leaves. Native of North America, and now common in the garden.

Kal. *Glauca*, Glaucous Kalmia; with opposite oblong polished leaves, hoary underneath, revolute on the margin, and with terminal corymbs. Native of Newfoundland, but now not uncommon in the garden.

A curious structure is observed in the flowers of this genus; when they first expand the anthers are imbedded in a cavity of the corolla, and, as the flower advances to maturity, they spring up successively; or the same thing may be seen by touching them gently with a sharp point.

Arbutus. *Gen. char.*—Cal. five-parted; cor. ovate, with the mouth five-cleft, pellucid at the base; berry superior, five-celled.

Arb. *Unedo*, Strawberry-tree; with arborescent stem, smooth, obtusely-serrated leaves, terminal panicle, and many-seeded berries. This fine shrub adorns the limestone rocks in the west of Ireland, and is abundant about the lake of Killarney.

Arb. *Alpina*, Black-berried Alpine Arbutus; with procumbent stems, and wrinkled, serrated leaves. Native of some of the higher mountains of the Highlands of Scotland, where it is distinguished by the reticulated veins of the leaves.

Arb. *Uva Ursi*, Red-berried trailing Arbutus; with procumbent stems and entire leaves. Common in the Highlands of Scotland, and near Hexham in Northumberland.

Order II. Digynia.

Hydrangea. *Gen. Char.*—Cal. five-cleft; cor. five-petaled; caps. two-celled, two-beaked, inferior, opening between the styles.

Hyd. *Arborescens*, Shrubby Hydrangea; with a woody stem. A native of Virginia, and long an inhabitant of some gardens in England.

Hyd. *Hortensis*, Garden Hydrangea; with elliptical, serrated, very smooth leaves, and equal stamens. This magnificent plant, which, from being so common, ceases to be admired, is remarkable for the changes in the progress of flowering. The blossoms are at first green, then rose-coloured, and, last of all, green a second time; and the plant which has produced red flowers one year, shall send forth blue flowers the next, although treated in the same manner. It is a native of China and Japan, where it is also cultivated for the sake of its beauty, and was introduced from China to the gardens at Kew in 1790.

Saxifraga. *Gen. Char.*—Cal. five-parted; cor. five-petaled; caps. two-beaked, one-celled, many-seeded.

Sax. *Umbrosa*, London Pride, None-so-pretty; with obovate leaves, and naked paniculated stem. Native of some high mountains in Ireland, and of some parts of England, and one of the most common plants in the flower-garden.

Sax. *Granulata*, White Saxifrage; with kidney-formed, lobed leaves, paniculated stem, and granulated root. Frequent in meadows and pastures of a gravelly soil, and is not uncommon in the garden with double flowers.

Sax. *Hypnoides*, Mossy Saxifrage, or Lady's Cushion; with linear leaves, entire, or three-cleft; on mountainous places, as on Arthur's Seat, Edinburgh.

Sax. *Crassifolia*, Oval-leaved Saxifrage; with oval crenulated leaves, and naked stem. Native of the Alps of Siberia, but common in the garden, and easily distinguished by its large leaves, which are red on the under, and of a fine shining green on the upper surface, and by its tall stem supporting a large bunch of purple pendulous flowers, which appear early in spring.

Sax. *Sarmentosa*, Strawberry Saxifrage; with radical leaves, roundish, heart-shaped, notched, axillary, rooting runners; irregular corolla, and compound raceme. Native of China, but very common as an ornament of the greenhouse and parlour. This species is particularly distinguished by its variegated leaves and the unusual size of the two lowermost pendant petals of the flower. By some unaccountable mistake, it is vulgarly called an Otaheite plant.

Dianthus. *Gen. char.*—Cal. cylindrical, one-leafed, scaly at the base; petals five, furnished with claws; caps. cylindrical, superior, one-celled.

Dian. *Caryophyllus*, Clove, Pink, or Carnation; with solitary flowers, scales of the calyx very short, and somewhat rhomboidal, petals notched, and without beard. Native of England, and found on ancient walls, as on Rochester and Deal castles; and from this species numerous varieties have been obtained by culture.

Dian. *Deltoides*, Maiden Pink; with solitary flowers, scales of the calyx about two, ovate lanceolate acute leaves, slightly downy; in sandy and gravelly pastures, as in the north side of the King's park at Edinburgh.

Dian. *Barbatus*, Bearded Pink, or Sweet William; with fasciculated, aggregated flowers; scales of the calyx ovate, awl-shaped, equal to the tube. Native of Germany, but long an ornament of the flower-garden in this country, where it exhibits endless varieties of colours, and appears occasionally with double flowers.

Decandria.

Dian. *Chinensis*, China or Indian Pink; with solitary flowers, scales of the calyx open, equal to the tube, and corolla notched. Native of China, and, recommended by the brilliancy and variety of its colours, among the annuals of the flower-garden.

Order III. Trigynia.

Stellaria. *Gen. char.*—Cal. five-leaved, spreading; petals five, two-parted; caps. superior, one-celled, many-seeded, six-toothed at the summit.

Stel. *Media*, Common Chickweed; with ovate leaves, and stems procumbent, with an alternate hairy lateral line; an annual; common every where; flowering throughout great part of the year. The number of stamens is observed to vary from ten to five.

Stel. *Holostea*, Greater Stitchwort; with serrulated lanceolate leaves, two-cleft petals, and cal. without nerves; in dry woods and among bushes.

Stel. *Graminea*, or Lesser Stitchwort; with linear, lanceolate, entire leaves, and three-nerved calyx nearly equal to the petals. In pastures and hedges in a dry soil.

Stel. *Nemorum*, Wood Stitchwort; with lower leaves heart-shaped, and with footstalks; upper leaves ovate and sessile. In moist, shady woods, but not very common. It is readily distinguished by its larger leaves and more specious flowers.

Arenaria. *Gen. char.*—Cal. five-leaved, spreading; petals five, entire; caps. superior, one-celled; many-seeded.

Ar. *Peploides*, Sea-chickweed, or Sandwort; with ovate, acute, fleshy leaves; cal. obtuse, and without nerves; perennial; flowers in June and July, and is frequent on sandy shores.

Ar. *Verna*, Vernal Sandwort; with bluntish awl-shaped leaves, obovate petals longer than the three-nerved calyx; perennial; continues in flower from May to August, and is a native of mountainous districts, as on Arthur's Seat, near Edinburgh, and about the mouths of lead-mines in Derbyshire.

Order IV. Pentagynia.

Sedum. *Gen. char.*—Cal. five-cleft; cor. five-petaled; five nectariferous scales at the base of the germen; capsules five, superior.

Sed. *Acre*, Biting Stone-crop, or Wall Pepper; with alternate, subovate, fleshy, gibbous leaves, and trifid leafy cymes; perennial; flowers in June, and is very common on walls, houses, and sandy places.

Sed. *Villosum*, Hairy Stone-crop; with alternate linear, somewhat plain, leaves; slightly hairy footstalks, and upright stem. Perennial; flowers in July, and is found in moist elevated pastures, as in the northern counties of England, and on the banks of the water of Leith, near its sources in the Pentland hills, in Scotland.

Oxalis *Acetosella*, Common Wood Sorrel. Cal. five-leaved; petals five, united by the claws; caps. superior, five-celled, opening at the angles; seeds enclosed in an elastic covering; stem one-flowered; leaves ternate, obcordate, hairy. Perennial; flowers in May, and is common in shady woods.

Agrostemma *Githago*, Corn-Cockle. Cal. one-leafed, leathery; petals five, clawed, with obtuse and divided limb; caps. superior, one-celled, with five-toothed mouth; calyx shaggy, longer than the corolla; petals entire, naked. An annual plant; flowers in June and July, and is common among corn.

Decandria.

Lychnis. *Gen. char.*—Cal. one-leafed, oblong; petals five, clawed; limb often divided; caps. superior, opening, five-toothed; from one to two-celled.

Lych. *Flos-cuculi*, Meadow Lychnis, or Ragged Robin; with four-cleft petals, and one-celled roundish capsule; perennial; flowers in June, and a very common plant in moist meadows.

Lych. *Viscaria*, Red German Catchfly; with undivided petals, and five-celled seed-vessel; perennial; flowers in June, and is found in the fisures of rocks, but is rather a rare plant, although abundant on the rocks of the King's park at Edinburgh.

Lych. *Dioica*, Red or White Campion, as it varies in the colour of its flowers; with diœcious flowers, and one-celled capsule; perennial; continues in flower through the summer, and is common in moist woods and hedges.

Cerastium. *Gen. char.*—Cal. five-leaved; petals two-cleft; caps. superior, opening at the summit, mouth ten-toothed, one-celled.

Cer. *Vulgatum*, Broad-leaved Mouse-ear Chickweed; rough, viscid, with ovate leaves, petals equal to the calyx, and flowers longer than the peduncle; annual; flowers in May, and is common in pastures, waste places, and on walls.

Cer. *Latifolium*, Bruad-leaved Rough Chickweed; with rough elliptical leaves, and terminal, simple, nearly solitary flower-stems; perennial; flowers in June, and is not uncommon on the mountains of Wales and Scotland, as on Benlomond.

Some species of Cerastium are deficient in the parts of fructification, as *Semidecandrum*, which has five stamens, and *Tetrandrum*, which has only four petals and four stamens.

Spergula. *Gen. char.*—Cal. five-leaved, petals five, entire; caps. superior, ovate, one-celled, five-valved.

Sper. *Arvensis*, Corn-Spurrey; with whorled leaves, flower stems reflected, seeds kidney-shaped. Annual; flowers in July and August, and is a troublesome weed in poor exhausted soils.

Sper. *Nodosa*, Knotted Spurrey; with opposite, awl-shaped, smooth leaves; upper leaves fasciculated; calyx without nerve. Perennial; flowers in July and August, and is frequent in moist sandy places.

Order V. Decagynia.

Phytolacca, American Nightshade or Pokeweed; cal. five-leaved, resembling a corolla; cor. none; berry ten-celled.

The species of this genus are natives of America, Africa, and India, and are conveniently distinguished by the variable number of stamens and pistils.

Phyt. *Decandra*, Redweed or Foxglove; with ten stamens and ten styles; a native of Jamaica, where it is very common; it produces reddish berries, which were employed to deepen the colour of red wines; to prevent which a severe edict, even on pain of death, was issued by the King of France. The seeds are used by the negroes for washing linen; they are very bitter, and communicate the same taste to the flesh of birds which feed on them.

Phyt. *Octandra*, Spanish Calalue; flowers with eight stamens and eight styles; native of Jamaica, and cultivated in the kitchen gardens of the island as a palatable green.

Class XI. Dodecandria.

Stamens from 12 to 20. Six Orders.

Order I. Monogynia.

Asarum *Europæum*, Asarabacca. Cal. three-cleft, sitting on the germen; cor. none; stamens twelve; caps. leathery, six-celled, crowned; stigma six-cleft; leaves kidney-formed, obtuse, in pairs. Perennial; flowers in May, and is a native of the woods of the north of England, but rare. The dried root in powder is employed to provoke sneezing and the flow of mucus in the nostrils.

Rhizophora *Mangle*, Mangrove. Cal. four-parted, inferior; cor. four-parted; seed one, club-shaped; a fleshy receptacle; leaves acute. Native of Jamaica, and rises to the height of 30 or 40, and even 50 feet. The Mangrove-tree is generally found on the borders of the sea, in whose waters only it seems to thrive, and in such places as have a soft bottom. The larger branches throw out soft leafless shoots, which bend downward, and in a short time reach the mud, where they strike root, and become supports to the parent tree. The American oyster attaches itself to those branches of the Mangrove tree which dip in the water, and from hence has arisen the fabulous account of this shell fish growing on trees.

Lythrum *Salicaria*, Purple Loose-strife. Cal. twelve-cleft; inferior petals six, inserted in the calyx; caps. two-celled, many seeded; leaves opposite, heart-shaped lanceolate; flowers spiked, with twelve stamens. Perennial; flowers in July and August, and is a fine ornament to marshy places and banks of rivers, where it is most common.

Halesia *Tetraptera*, Four-winged Snowdrop Tree. Cal. four-toothed, superior; cor. four-cleft; nut quadrangular, four-celled; seeds solitary; leaves ovate, pointed, with hairy veins on the lower surface; wings of the seed equal. Native of South Carolina; flowers in April and May, and, from the beauty of its flowers, might be a fine ornament to pleasure grounds in this country. *Bot. Mag.* 910.

Order II. Digynia.

Heliocarpus *Americana*, Sun-seed. Cal. four-leaved; cor. four-petaled; caps. two-celled, one-seeded. Native of Vera Cruz, and remarkable for the fringed or radiated structure of its fruit.

Agrimonia *Eupatoria*, Common Agrimony. Cal. five-toothed, calyculated, or with a double calyx; petals five, inserted in the calyx; seeds two, in the bottom of the calyx; stem leaves pinnated, the odd leaflet with a foot-stalk; seeds rough, with hooked bristles. Perennial; flowers in June and July, and is common in woods and on the borders of fields.

Order III. Trigynia.

Reseda. *Gen. char.*—Cal. one-leaved, divided; cor. with petals, much divided; caps. superior, opening at the summit, one-celled, many-seeded.

Res. *Luteola*, Dyers' Weed, Yellow Weed, or Weld; with lanceolate, entire, plain leaves; cal. four-cleft. Annual; flowers in July, and is not uncommon in waste places and near walls; it is also cultivated on account of the yellow dye which it affords.

Res. *Lutea*, Wild Mignonette, or Base Rocket; with all the leaves three-cleft, the inferior pinnated; cal. six-cleft. Annual or perennial; flowers in July and August, and is not uncommon in dry soils.

Res. *Odorata*, Mignonette; with leaves entire and three-lobed, the calyx equal to the flower; native of Egypt, but a peculiar favourite of the garden and parlour, on account of the sweet fragrance of its flowers.

Euphorbia. *Gen. char.*—Cal. one-leaved, ventricose, inferior; nectaries four or five, attached to the calyx; caps. with a foot-stalk, three-celled.

Euph. *Peplus*, Petty Spurge; with trifid umbel, branches divided into two, leaves entire, obovate, foot-stalked; annual; flowers in July and August, and is very common in cultivated grounds.

Euph. *Exigua*, Dwarf Spurge; umbel trifid, branches divided, leaves linear; annual; flowers in July, and is common among corn.

Euph. *Helioscopia*, Sun Spurge, or Wartwort; umbel five-cleft, leaves serrated, wedge-shaped; annual; flowers in July and August, and is very common in cultivated places.

Order IV. Tetragynia.

To this order belong *Calligonum*, the species of which are natives of Russia and Siberia, and have been illustrated by L'Heritier, *Transact. Linn. Society, Vol. I.*; and *Aponogeton*, the species of which are aquatic plants, and natives of the Cape and of the East Indies. Two genera are arranged under the fifth order; but they are little known, or indistinctly discriminated.

Order VI. Hexandria.

Cephalotus *Follicularis*, Pitcher Plant. This singular plant was discovered by Labillardiere, on the southern shores of New Holland; and it was found by Mr Brown in marshy places in the neighbourhood of King George's sound. The peculiarity of its structure is in certain appendages called ascidia, or pitchers, which are supported by foot-stalks, and are arranged in a circle around the leaves. "The ascidia, or pitchers of Cephalotus," says Mr Brown, "were observed to be in general nearly half filled with a watery fluid, in which great numbers of a small species of ant were frequently found drowned. This fluid, which had a slightly sweet taste, might possibly be in part a secretion of the pitcher itself, but more probably consists merely of rain water received and preserved in it. The lid of the pitcher, in the full grown state, was found either accurately closing its mouth, or having an erect position, and therefore leaving it entirely open; and it is not unlikely that the position of the lid is determined by the state of the atmosphere, or even by other external causes."—Append. to *Flinder's Voyage*. See Plate 32. Fig. 4.

Order VII. Dodecagynia.

Sempervivum. *Gen. char.*—Cal. inferior, twelve-parted; petals twelve; caps. twelve, many-seeded.

Semper. *Tectorum*, Common House-leek; leaves ciliated, with spreading shoots. Perennial; flowers in July, and frequent on houses and walls.

Semp. *Arachnoideum*, Cobweb House-leek; with leaves interwoven with hairs. Native of the Alps of Switzerland, but is not uncommon in gardens. The singular appearance of this plant arises from the woolly tops of the leaves; for as they expand the woolly substance is extended, and exhibits somewhat of the structure of a cobweb.

Class XII. Icosandria.

Twenty or more Stamens on the calyx; Three Orders.

Order I. Monogynia.

Cactus. Cal. superior, one-leaved, imbricated; cor. many-cleft; berry one-celled, many-seeded.

Cact. *Flagelliformis*, Creeping Cereus; with creeping angular shoots; native of the West Indies, but not an unfrequent inmate in the stove or green-house, where it cannot fail to be admired on account of the brilliancy of its flowers.

Numerous other species belong to this genus; they are all natives of warm climates; and on one of them, Cact. *Cochenillifer*, the precious Cochineal insect makes its abode.

Philadelphus *Coronarius*, Mock Orange. Cal. four or five-parted, superior; petals four or five; caps. four or five-celled, many-seeded; leaves somewhat toothed. Supposed to be a native of the south of Europe, but it is now one of the most common shrubs in the garden.

Myrtus. *Gen. char.*—Cal. superior, five-toothed; petals five; berry striated, seven-celled.

Myrt. *Tomentosa*, Woolly-leaved Myrtle; with one-flowered peduncles; leaves triply nerved, woolly on the under surface. A native of China, and is cultivated in the stove in this country, on account of the beauty of its foliage and flowers.

Myrt. *Communis*, the Common Myrtle, a native of Italy, is rarely absent from collections of plants in the green-house or parlour.

Myrt. *Pimenta*, Jamaica Pepper, or Allspice Tree; with oblong lanceolate leaves. Native of the West India islands. This fine tree, which grows spontaneously and abundantly in Jamaica, rises to the height of 30 feet, and is remarkable for the beauty of its leaves, which are of a deep shining green. The Pimenta plantations are chiefly on the north side of the island; and nothing can exceed the fragrance which is exhaled from these spicy groves. Soon after the trees are in blossom the berries are fit for gathering, for they are not suffered to ripen on the tree; they are then collected and spread on a terrace; and being exposed to the sun for about a week, they are ready for the market. A single tree sometimes yields a hundred weight of dried spice; and more than 170,000 lbs. weight are annually exported from Jamaica. The name, *Allspice*, is derived from the smell and taste, resembling that of a mixture of cloves, cinnamon, and nutmegs.

Eucalyptus. Cal. superior, truncated, covered with a lid; no corolla; caps. four-celled, many-seeded. Of this genus nearly 100 species have been discovered; most of them are trees, and some of them rival in height and magnitude the tallest vegetable productions. Eucalyptus *Globulus*, and another species peculiar to the southern extremity of Van Diemen's island, rear their lofty heads 150 feet, and are from ten to twelve feet in diameter. With one exception only, all the species of this genus are confined to New Holland.

Metrosideros *Citrina*, Harsh-leaved Metrosideros. Cal. five-toothed, including the germen; petals five, deciduous; stamens separate, many times longer than the petals; leaves linear, lanceolate, rigid. Native of Botany Bay, but not uncommon in the nurseries about London. The generic name is derived from the hardness of the wood. In the structure of its flowers it is nearly allied to the splendid genus *Melaleuca*; and for all its beauty, it is indebted to the brilliant scarlet colour of its long filaments. *Bot. Mag.* 260; and Plate 32. Fig. 5.

Psidium *Pyriferum*, Guava. Cal. superior, five-cleft; cor. five-petaled; berry one-celled, many-seeded; leaves elliptic, peduncles one-flowered. A common tree in the pastures of Jamaica, growing from eight to twelve feet high; the fruit is eaten raw or stewed with milk, and it affords an excellent marmalade and a richly flavoured jelly.

Psid. *Montanum*, is also a native of Jamaica, and rises to the height of 60 or 70 feet, producing also an agreeable fruit and a valuable wood.

Amygdalus. *Gen. char.*—Cal. inferior, five-cleft; cor. five-petaled; drupe, a nut, marked with pores.

This genus includes the Peach, Amyg. *Persica*, a native of Persia; the Almond-tree, Amyg. *Communis*, which by difference of culture affords bitter and sweet almonds, is a native of Barbary, but is cultivated in the south of Europe; and Dwarf Almond, Amyg. *Nana*, with leaves tapering at the base, a native of Russia and Tartary, and one of the most delicate ornaments of the shrubbery in early spring.

Prunus. *Gen. char.*—Cal. inferior, five-cleft; cor. five-petaled; drupe, with an entire kernel.

Icosandria.

Prun. *Padus*, Bird Cherry; with flowers in pendulous racemes; not uncommon in woods and hedges in Britain, especially in the north of England.

Prun. *Spinosa*, Sloe-tree, or Black Thorn; with solitary peduncles, smooth lanceolate leaves, and spinous branches; common in hedges and among brushwood, and flowers early in the spring.

To this genus belong Bullace-tree, Prun. *Insititia*, with double peduncles, and branches ending in a spine; common in hedges and woods: the Cherry-tree, Prun. *Cerasus*, of which numerous varieties arise from culture: and the Plum-tree, Prun. *Domestica*, of which the varieties are not less numerous.

Order II. Pentagynia.

Mespilus. *Gen. char.*—Cal. five-cleft, petals five, drupe inferior, from two to five-seeded.

Mesp. *Oxyacantha*, Hawthorn, White-thorn, or May; spinous, with obtuse nearly three-cleft, smooth, serrated leaves; flower with two pistils. This plant, of which varieties are produced by culture, is well known for its important application in making living hedges, for which it is admirably fitted by the stiffness of its branches, the sharpness of its thorns, and hardy nature.

Mesp. *Germanica*, Common Medlar; is without spines, has downy leaves, and flowers with five styles; is not uncommon in gardens and shrubberies.

Pyrus. *Gen. char.*—Cal. five-cleft; petals five; pome or apple, inferior, from two to five-celled, seeds two.

Pyr. *Communis*, Pear-tree; with simple serrated leaves, and corymbose peduncles; in woods and hedges; but the cultivated varieties are almost endless.

Pyr. *Malus*, Crab-tree, or Apple-tree; with simple serrated leaves, and simple sessile umbels; native of woods and hedges, and the parent of all the cultivated varieties of the apple.

Pyr. *Aucuparia*, Mountain Ash, Quicken or Roan-tree; with smooth pinnated leaves, leaflets serrated; common in woods and hedges, and deservedly admired for its white flowers in the early summer, and scarlet berries in the autumn.

Mesembryanthemum. *Gen. char.*—Cal. five-cleft, petals numerous, linear; caps. fleshy, inferior, many-seeded.

Mesem. *Dolabriforme*, Hatchet-leaved Fig Marygold; is a native of the Cape, and is easily distinguished by the form of the leaves, of which the specific name is descriptive.

Most of the species belonging to this genus are remarkable for the form or structure of their leaves, and many of them are peculiarly distinguished by the beauty and brilliancy of their flowers. Not fewer than fifty species, chiefly natives of the Cape, have been discovered, one of which Mesem. *Crystallinum*, the ice-plant, is a well known annual.

Spiræa. *Gen. char.*—Cal. five-cleft, petals five, capsules superior, two-valved, many-seeded.

Spir. *Filipendula*, Common Dropwort; with leaves interruptedly pinnated, leaflets uniform, smooth, serrated; not uncommon in dry pastures, and cultivated in the garden, where it varies with double flowers.

Icosandria.

Spir. *Ulmaria*, Meadow-sweet, or Queen of the Meadow; with leaves interruptedly pinnated, woolly underneath; the odd leaflet large and lobed; very common in moist meadows, and on the banks of rivers.

Order III. Polygynia.

Rosa. *Gen. char.*—Cal. pitcher-shaped, five-cleft, fleshy, contracted at the neck; petals five; seeds numerous, attached to the inside of the calyx.

Ros. *Spinosissima*, Burnet Rose; with globular fruit, and smooth peduncles, stem covered with numerous prickles; common on the borders of fields, and among brushwood in a sandy soil.

Ros. *Canina*, Common Dog-rose, Wild Brier, or Hep-tree; with ovate fruit, smooth peduncles, and prickles on the stem hooked; very common in hedges and among brushwood.

Ros. *Rubiginosa*, Sweetbrier, or Eglantine; with ovate fruit, rough peduncles, and prickles on the stem hooked; in mountainous places, but well known in the garden for its charming fragrance.

Numerous other species of the rose have been described, and equally numerous varieties have been produced by culture. The Yellow Rose is a native of Germany; the Moss Rose, supposed by some to be a variety of the Provence, and by others, of the Hundred-leaved Rose; and the China Rose, *Semperflorens*, which is seldom without flowers, is a fine ornament of the green-house and the parlour.

Rubus. *Gen. char.*—Cal. five-cleft, petals five, berry superior, composed of one-seeded acini.

Rub. *Idæus*, Raspberry; with leaves five-pinnated and ternate, woolly underneath, foot-stalks channelled, stem prickly; common in woods, and cultivated in the garden.

Rub. *Fruticosus*, Common Bramble; with leaves about five together, woolly underneath, leaflets foot-stalked, prickles hooked, stem angular, and calyx reflected. One of the most common plants.

Rub. *Chamæmorus*, Mountain Bramble; with simple lobed leaves, one-flowered, unarmed; stem and segments of the calyx ovate; not uncommon on the higher mountains of Scotland, Wales, and the north of England.

Fragaria. *Gen. char.*—Cal. ten-cleft, inferior; petals five; receptacle of the seeds ovate, berry deciduous, seed smooth.

Frag. *Vesca*, Wood Strawberry; with creeping runners; frequent in woods and hedges.

Frag. *Sterilis*; Barren Strawberry; with declining stem and loose flower bearing branches, with about two flowers; common in barren pastures.

Potentilla. *Gen. char.*—Cal. ten-cleft, inferior; petals five; seeds roundish, naked, often wrinkled, attached to a small dry receptacle.

Pot. *Anserina*, Silverweed or Wild Tansy; with pinnated, serrated leaves, silky underneath; creeping stem, one-flowered peduncles; very common in moist meadows and by way-sides.

Pot. *Fruticosa*, Shrubby Cinquefoil; with pinnated leaves, and shrubby stem; said to be a native of Yorkshire, but is commonly cultivated in shrubberies.

Geum. *Gen. char.*—Cal. ten-cleft, inferior; petals five; awn of the seeds bent.

Ge. *Urbanum*, Common Avens, or Herb Bennet; with ternate leaves, erect flowers, and naked, hooked awns; very common in woods and hedges.

Ge. *Rivale*, Water Avens; with radical leaves lyre-shaped, nodding flowers, and feathery twisted awns; common in moist places, and on the banks of rivers.

Calycanthus *Floridus*, Carolina All-spice; cal. one-leaved, pitcher-shaped, with the leaflets coloured; styles very many, with a glandular stigma, interior petals longer; native of Carolina, and has been long in the gardens of this country, where it is kept in the green-house and conservatory. The bark of this plant has an agreeable aromatic odour, from which the name is derived; it seems to approach to the flavour of ginger.

Cal. *Præcox*, Japan All-spice; with the interior petals small; is cultivated in Japan as an ornamental plant, and has been introduced into the gardens of this country, where it is deservedly admired for the vast profusion of its flowers, and the remarkable fragrance, which diffuses to a great distance.—*Bot. Mag.* 466.

Class XIII. Polyandria.

In this class the Stamens amount to twenty or more, and they are inserted in the receptacle. It is divided into Seven Orders.

Order I. Monogynia.

Papaver. *Gen. char.*—Cal. two-leaved; petals four; stigma radiated; caps. superior.

Pap. *Argemone*, Long Rough-headed Poppy; with rough, club-shaped capsules, many-flowered, leafy stem; annual; flowers in July, and is not uncommon in fields.

Pap. *Rhœas*, Red Poppy, or Corn Rose; with smooth, somewhat globular capsules; rough, many-flowered stem; leaves pinatifid. Common among corn, and annual.

Pap. *Somniferum*, White Poppy; with cal. and caps. smooth, leaves glaucous, cut, embracing the stem; annual; and cultivated in the East for supplying the demands of commerce with the valuable drug opium, which is the inspissated milky juice of the capsules.

Cistus. *Gen. char.*—Cal. five-leaved, with the leaflets unequal; petals five; caps. superior, angular, three-valved, many-seeded.

Cist. *Helianthemum*, Common Dwarf Cistus; shrubby, procumbent, with elliptic oblong leaves, hoary underneath; common in dry upland pastures.

Many species of this genus are cultivated in the garden: Among which,

Cist. *Formosus*, or Beautiful Cistus, a native of Portugal, appears conspicuous for its specious flowers.

Capparis *Spinosa*, Caper Bush. Cal. four-leaved; berry with a footstalk. This species is a low, prickly shrub, a native of Italy, the buds of which, preserved in vinegar, are well known under the name of capers.

Sanguinaria *Canadensis*, Canada Puccoon, or Bloodwort. Cal. two-leaved; cor. eight-petaled; pod ovate, one-celled. Native of Canada, and remarkable for the singular structure of its leaves, and the bright red or orange-coloured juice of its roots. It has been long cultivated in this country.

Sarracenia *Flava*, Yellow Side-saddle Flower. Cal. double, three and five-leaved; cor. five-petalled; caps. five-celled; stigma in the form of a shield; leaves tubular, erect; valve contracted at the neck. Common in the swamps of North America. The tubular structure of the leaves of this plant has exercised the ingenuity of physiological botanists; but they have not succeeded in ascertaining its use. Other species are cultivated in this country. *Bot. Mag.* 780, and 849.

Nymphæa. *Gen. char.*—Cal. four or five-leaved; cor. many-petalous; stigma radiated, sessile; berry superior, many-celled.

Nymph. *Lutea*, Yellow Water-lily; with cal. five-leaved, larger than the petals; stigma entire; leaves entire, heart-shaped. Not uncommon in rivers and lakes.

Nym. *Alba*, White Water-lily; with four-leaved calyx, and lobed stigma. Frequent in rivers and lakes, where it is easily recognised by its large white flowers.

Nym. *Lotus*, Egyptian Water-lily, or Lotus; with heart-shaped, very smooth, toothed leaves. Native of Egypt and of the East Indies, and an object of veneration among the inhabitants of both countries. A native of Nepaul, seeing the flowers of this plant in Sir William Jones's study, made prostrations before it. *Bot. Mag.* 797.

Tilia *Europæa*, Lime or Linden Tree. Cal. five-parted; petals five; cap. superior, leathery, angular, five-celled, five-valved, opening at the base. *Spec. char.*—Flowers destitute of nectary, leaves heart-shaped; branches of the veins downy. In woods and hedges.

Corchorus. *Gen. char.*—Cal. five-leaved, length of the corolla, deciduous; caps. about five-celled.

Cor. *Siliquosus*, Podded Broom-weed; with linear compressed capsules, and lanceolate leaves. A native of Jamaica, where it grows to the height of three feet.

Cor. *Olitorius*, Common Jews Mallow; with oblong, ventricose capsules; grows to the height of two feet, and is cultivated as a pot-herb at Aleppo. The Jews boil the leaves, and eat them with their meat.

Cor. *Japonicus*, Japan Broom-weed; with doubly serrated, heart-shaped, acuminated leaves, and smooth round stem; has become, on account of its fine double yellow flowers, a great favourite in the garden and parlour.

Polyandria.

Thea, Tea-tree. *Gen. char.*—Cal. five or six-leaved; petals six or nine; caps. three-celled; seeds solitary. Two species, Thea *Viridis* and Thea *Bohea*, are described as distinct by some botanists, while they are considered by others as only varieties. In the first, or the green tea, the stem is covered with a thin, ash-coloured bark; the leaves are oval, pointed, serrated, and of a deep green. In the bohea, the branches of the foot-stalks of the leaves and flowers are reddish, the leaves are larger, wrinkled, and of a pale bluish green.

The two species or varieties are cultivated in China and Japan. The leaves are collected at three different periods, at the end of February, of March, and April. The leaves of the first crop, which are the smallest, are most esteemed, and, it is said, are reserved for the princes and persons of rank in Japan and China; and the produce of the two later crops is exported to Europe. When the leaves are collected, they are roasted on iron plates to make them shrivel up; and for the same purpose, the better kinds of tea leaves are rolled in the palm of the hand. Before roasting, the Chinese immerse the leaves for a few minutes in boiling water; which process has given rise to a report, that the tea which they export has been already infused.

The varied preparations to which the leaves are subjected, the period of collecting them, the age of the shrub, and the influence of the soil where it is cultivated, produce the varieties of tea in commerce, which are distinguished by different names, and sold at very different prices. The finest and most highly flavoured tea, it is said, is brought from China by land to Petersburgh.

The Chinese method of infusing tea is usually practised in Europe; but the Japanese reduce the dried leaves to fine powder, and add a small spoonful of this powder to a cup of boiling water. Beside the ordinary use of tea, it is perhaps little known, that it is sometimes employed as an addition to the usual ingredients in punch.

Bixa *Orellana*, Annotto. Caps. five-toothed; cor. five-petaled, double; caps. two-valved. Native of the West Indies and of some parts of the American continent; rises to the height of 10 or 12 feet, and yields, from the pulpy matter which covers the seeds, the dye-stuff called Annotto; for the preparation of which, see Annotto.

Order II. Digynia.

Pæonia. *Gen. char.*—Cal. five-leaved; petals five, regular; germens from two to five; no style; caps. many-seeded.

The common Pæony Rose is a splendid ornament of the garden and shrubbery; and Pæonia *Tenuifolia*, Fine-leaved Pæony, with doubly ternate leaves, and leaflets much divided, and naked, produces a specious flower—is a native of the Ukraine, and is found to be a hardy perennial in the gardens of this country.

Order III. Trigynia.

Delphinium. *Gen. char.*—Cal. none; petals five, the uppermost with a spur; nectary two-cleft, spur-shaped behind.

Del. *Consolida*, Field Lark-spur; with solitary capsule, one-leafed nectary, and subdivided stem. Native of some parts of England.

Del. *Ajacis*, Larkspur; is one of the most common annuals in the flower-garden.

Aconitum, or Monk's-hood, of which there are many species, belongs also to this order.

Order IV. Tetragynia.

Under this order are arranged *Wintera Aromatica*, a tree which is a native of South America, and from which is obtained the winter's-bark of the shops.

Order V. Pentagynia.

Aquilegia *Vulgaris*, Common Columbine. Cal. none; petals five; nectaries five, horned, and arranged among the petals; caps. five, distinct. *Spec. char.*—Nectaries bent inwards, scarcely equal to the petals; stem and leaves smooth. In mountainous pastures in England, but, with numerous varieties, cultivated in gardens.

Order VI. Hexagynia.

Stratiotes *Aloides*, Water Aloe, or Water Soldier. Spathe two-leaved; perianth superior; three-cleft; petals three; berry six-celled. *Spec. char.*—Leaves sword-shaped, triangular, prickly, serrated. In marshy places of Lincolnshire and Norfolk.

Order VII. Polygynia.

Anemone. *Gen. char.*—Cal. none; cor. six-petaled; seeds many.

An. *Nemorosa*, Wood Anemone; with one-flowered stem, furnished with a three-leaved involucrum, supported on a foot-stalk. Very common in woods.

An. *Pulsatilla*, Pasque-flower; is also a native of England. An. *Hepatica*, is well known in gardens for its early double flowers; and the beautiful varieties of the Anemone, with double flowers, constitute some of the chief ornaments of the flower-garden.

Ranunculus. *Gen. char.*—Cal. five-leaved; petals from five to eight, with a honey pore within the claws; seeds naked.

Ran. *Flammula*, Lesser Spearwort; with ovate, lanceolate leaves on footstalks; stem declining. Common in marshy places.

Ran. *Lingua*, Great Spearwort; with lanceolate pointed leaves, many flowered, erect stem. In marshy places, but less common.

Ran. *Ficaria*, Pilewort, or Lesser Celandine; with heart-shaped leaves on footstalks. Common in meadows and moist places, and one of the earliest flowers of the spring.

Liriodendron *Tulipifera*, Common Tulip tree. Cal. three-leaved, petals six; seeds imbricated in the form of a cone; leaves lobed. This splendid tree, which, in its native soil in North America, grows to the height of 70 or 80 feet, is successfully cultivated in this country; and one of them, in Mr Ord's garden at Walham-green, near London, is every year covered with blossoms. *Bot. Mag.* 275. See Plate 32. Fig. 6.

Annona. *Gen. char.*—Cal. three-leaved, cor. six-petaled, berry many-seeded, with an imbricated covering.

An. *Muricata,* the Sour Sop, an agreeable acid fruit, and An. *Squamosa,* Sweet Sop, the fruit of which is sweetish, are both natives of Jamaica.

Class XIV. Didynamia.

The plants of this class have four stamens, and the character depends on their unequal length; two of them are long and two short, by which they are distinguished from plants in the fourth class. The corolla is irregular in its form. This class is divided into two orders; the first, *Gymnospermia,* in which the seeds are naked; and the second, *Angiospermia,* in which the seeds are contained in a capsule.

Order I. Gymnospermia.

Ajuga *Reptans,* Common Bugle. *Gen. char.*—The upper lip of the corolla smallest, notched, stamens longer than the upper lip; plant smooth, with single stem, and creeping shoots. Common in woods and moist pastures.

Teucrium *Scorodonia,* Wood-sage. Cor. with no upper-lip, but divided to the base; stamens protruded; leaves heart-shaped, serrated, on footstalks, with lateral racemes; the flowers on one side; erect stem. Common in woods and heaths.

Mentha. *Gen. char.*—Cor. nearly equal, four-cleft, with the broader segment notched; cal. five-cleft; stamens erect and distant.

Of this genus, 12 species, with numerous varieties under most of them, are described as native plants.

Men. *Viridis,* Spearmint; has interrupted spikes; leaves sessile, lanceolate, acute, naked; bracteas bristly, and teeth of the calyx somewhat rough.

Men. *Piperita,* Peppermint; has obtuse spikes, interrupted at the lower part; leaves subovate, smoothish, on footstalks; base of the calyx very smooth. Both are natives, and grow in marshy and moist places, but are extensively cultivated for medical purposes.

Lamium. *Gen. char.*—Cal. five-cleft, with bristly, spreading teeth; cor. upper-lip entire, arched, inferior, two-lobed, inflated, toothed on the margin on each side.

Lam. *Album,* White Dead-nettle; with heart-shaped, serrated, pointed leaves, on footstalks; flowers in whorls. Very common in waste-places about towns.

Lam. *Purpureum,* Red Dead-nettle; with heart-shaped, obtuse leaves, on footstalks; upper leaves crowded together. Annual, and very common in waste places and cultivated grounds.

Stachys. *Gen. char.*—Cal. five-cleft, bearded; cor. upper-lip arched, lower reflected at the sides; middle segment larger, notched; stamens towards the reflected sides, without anthers.

Sta. *Sylvatica,* Hedge Woundwort; with six-flowered whorls, and heart-shaped leaves on footstalks. Common in woods and hedges.

Sta. *Arvensis,* Corn-Woundwort, or Hedge-nettle; with six-flowered whorls, weak stem, and leaves heart-shaped, blunt, crenated, somewhat hairy. Annual, and common in gardens and gravelly soils.

Sta. *Coccinea,* Scarlet Stachys; with six-flowered whorls, and ovate, heart-shaped, crenated leaves, with dilated footstalks. Native of Chili, and seems hardy enough for the climate of this country. *Bot. Mag.* xviii. 666.

Sta. *Lanata,* Woolly Stachys; cultivated in gardens, remarkable for its woolly leaves and stem, and much sought after by the domestic bee.

Prunella. *Gen. char.*—Filaments two-forked at the summit, stigma two-cleft.

Prun. *Vulgaris,* Self-heal; with all the leaves ovate, oblong, and on footstalks. Perennial, and common in meadows and pastures.

Prun. *Grandiflora,* Great-flowered Self-heal; leaves ovate, oblong, slightly serrated, upper lip of the calyx deeply divided into three lobes. Native of the Alps, and, with its fine purple blossoms, is a hardy ornamental plant in the flower-garden. *Bot. Mag.* x. 337.

Order II. Angiospermia.

Rhinanthus *Crista-Galli,* Yellow-rattle, or Horse-rattle. Cal. inflated, four-toothed; shield of the corolla compressed, caps. two-celled, obtuse, compressed; seeds imbricated. *Spec. char.*—Upper lip of the corolla arched; cal. smooth; leaves lanceolate, serrated. Annual, and very common in meadows and pastures.

Euphrasia *Officinalis,* Eye-bright. Cal. cylindrical, four-toothed, equal; upper lip of corolla two-cleft, lower lip three-lobed, with two-cleft segments; anthers furnished with unequal spines. *Spec. char.*—Leaves ovate, minutely toothed. Very common in pastures and heathy grounds.

Antirrhinum. *Gen. char.*—Cal. five-parted, base of the corolla prominent downwards, nectariferous; caps. two-celled.

Ant. *Cymbalaria,* Ivy-leaved Snapdragon; with leaves heart-shaped, five-lobed, alternate, smooth; stems inclining. Perennial; originally introduced from Italy, but common on walls, on the banks of the Thames, about Oxford and Windsor castle, and beginning to appear on the walls near Edinburgh.

Ant. *Linaria,* Common Yellow-toad Flax; with lance-shaped, linear, crowded leaves; stem erect, spiked; cal. smooth, shorter than the nectary. Common in hedges and the borders of fields.

Ant. *Majus,* Great Snapdragon. Cor. without spur; flowers in spikes; cal. obtuse, hairy. Perennial, and a common plant in the flower-garden.

Digitalis *Purpurea,* Purple Foxglove. Cal. five-parted; cor. bell-shaped, five-cleft, inflated, caps. ovate, two-celled, many-seeded. *Spec. char.*—Segments of the calyx ovate, acute; corolla obtuse, upper lip entire; leaves downy. Common in woods and hedges in a sandy or gravelly soil, and varies sometimes with white flowers.

LINNÆA *Borealis*, Two-flowered Linnæa. Cal. double; cal. of the fruit two-leaved, of the flower five-parted, superior; cor. bell-shaped; berry dry, three-celled. This plant, which is intended to commemorate the venerable father of botany, is a native of the northern parts of Europe and America, and has been found in an old fir-wood in Aberdeenshire, in Scotland.

BIGNONIA. *Gen char.*---Cal. five-cleft, cup-formed; throat of corolla bell-shaped, five-cleft, inflated beneath, pod two-celled; seeds with membranaceous wings.

Big. *Radicans*, Ash-leaved Trumpet-flower; with pinnated leaves, leaflets gashed, stem jointed, rooting. Native of North America, and successfully cultivated as an ornamental climber in the neighbourhood of London, mounting to the summit of the loftiest tree, and spreading over the highest wall; and displaying, in August and September, a vast profusion of magnificent flowers. A tree of this species has been long an inhabitant of Chelsea-garden. *Bot. Mag.* xiv. 485. See Plate 32. Fig. 7.

Big. *Longissima*, French Oak, or Trumpet-flower; with simple, oblong-pointed leaves; stem erect, and woolly seeds. Native of Jamaica, and an elegant tree, which rises to the height of 40 feet. Some other species of Bignonia are natives of Jamaica; and it ought to be observed, that the irregular corolla of Big. *Radicans* sometimes assumes a regular form, and five stamens of equal length appear, so that it more properly belongs to the fifth class.

CRESCENTIA. *Gen. char.*—Berry one-celled, with a hard, woody covering; cor. with tube; bell-shaped germen, supported on a foot-stalk.

Cres. *Cujete*, Narrow-leaved Calabash, with wedge-shaped lanceolate leaves. Native of Jamaica; a tree which rises to the height of twenty feet, and is remarkable for the large size of its fruit, which is sometimes a foot in diameter; and the hard woody shell is employed by the negroes as bottles, cups, spoons, and other kitchen utensils. Another species is a native of Jamaica; but the shell of the fruit is so thin that it cannot be applied to the same purposes.

MELIANTHUS. *Gen. char.*—Cal. five-leaved, with the inferior leaf gibbous; petals four, with the nectary beneath the lowest; caps. four-celled.

Two species of this genus have been described, *Major* and *Minor*, both of which are cultivated in this country, and are remarkable for the copious secretion of honey, which is so abundant in the former as to drop from the flowers.

CLASS XV. TETRADYNAMIA.

In this class the character is derived from the unequal length of the stamens, four of which are long and two short, standing opposite to each other. The flowers are composed of four petals, arranged two and two opposite to each other, in the form of a cross, and hence are called cruciform flowers. This class is divided into two orders, characterised by the length of the pod.

ORDER I. SILICULOSA.

The plants belonging to this order have a roundish pod or pouch, which is sometimes called silicle, or little pod.

DRABA *Verna*, Common Whitlow Grass. Silicle entire, with plain valves parallel to the partition; stems naked; petals divided; leaves lanceolate, rough, slightly gashed. Annual, and one of the earliest flowers of the spring; is common on walls and dry pastures.

THLASPI *Bursa-Pastoris*, Common Shepherds' Purse. Silicle notched, obcordate, with valves margined, keeled; an annual plant, flowering through the summer, and everywhere common.

LUNARIA. *Gen. char.*—Silicle on a pedicle with flat valves; style protruded.

To this genus belongs a common plant in the garden, called Moonwort, Honesty, or Satin-flower, which last is derived from the silky appearance of the pod.

Under this order are comprehended *Crambe*, Sea-Cabbage, or Kale; *Lepidium*, one species of which, Lep. *Sativum*, is the well-known Garden Cress; *Cochlearia*, Scurvy Grass; and *Iberis*, Candytuft, remarkable for the inequality of its petals, and familiar in the flower-garden.

ORDER II. SILIQUOSA.

This order is distinguished by the fruit being in the form of a long pod.

CARDAMINE *Pratensis*, Meadow Lady's Smock, Cuckow-flower; pod opening with a spring; valves bent backward, equal to the partition; stigma entire; cal. slightly gaping; a single gland on both sides between the shorter stamens and the calyx; leaves pinnated; radical leaflets, roundish, toothed, those on the stem lanceolate. Perennial, and common in moist pastures, where it exhibits its fine purple or white flowers early in spring.

SISYMBRIUM. *Gen. char.*—Pod opening with upright valves; cal. and cor. spreading.

Sis. *Nasturtium*, Water-Cress; with declining pods, pinnated leaves, leaflets heart-shaped, roundish. Common in rivulets and near springs, and well known as one of the earliest salads for the table.

Sis. *Monense*, Isle of Man Rocket, or Dwarf Sea Rocket; with erect pods; pinnatifid leaves, simple, naked, smooth stems. This plant is very remarkable for its habitat. It is very abundant in dry pastures along the coast of Ayrshire, in Bute and Arran in Scotland, in the Isle of Man and in Cumberland in England, and in Anglesea in Wales, while a single plant has not been discovered in the eastern parts of the kingdom.

ERYSIMUM. *Gen. char.*—Pod straight, exactly square; cal. shut; stigma capitate.

Er. *Officinale*, Common Hedge-Mustard; with pods closely pressed to the stem, leaves runcinated. Annual; flowers in June and July, and is very common in waste places and by way-sides.

Er. *Barbarea*, Yellow Rocket, or Bitter Winter Cress; with inferior leaves lyre-shaped, terminal lobe round, upper leaves obovate, toothed. Perennial; flowers during the summer months, and is common in waste places, by river sides, and hedges, and cultivated in the flower-garden with double flowers.

Er. *Alliaria*, Garlic Hedge-Mustard, or Jack-by-the-Hedge; with heart-shaped leaves. Biennial; flowers in May, and is common in hedges and shady places, where it is at once recognized by the garlic odour which any part of the bruised plant exhales.

Cheiranthus *Fruticulosus*, Wild Wallflower; germen with a small tooth on each side furnished with a gland; cal. closed; seeds plain; leaves lanceolate, acute, hoary on the lower surface; stem shrubby; branches angular. Common on old walls. From the wild variety the wallflower of the garden is different in some of its characters, arising probably from culture.

Brassica. *Gen. char.*—Cal. upright, pod roundish, seeds globular.

To this genus belongs Bras. *Napus*, Rape; Bras. *Rapa*, Turnip; and Bras. *Oleracea*, the Cabbage; and the various species and varieties which are cultivated in gardens.

Sinapis. *Gen. char.*—Cal. spreading; claws of the corolla upright; pod roundish, with a prominent partition.

Three native species belong to this genus; Sin. *Arvensis*, Wild Mustard, or Charlock, with angular pods, a troublesome weed among corn; Sin. *Alba*, White Mustard, with rough pods, which grows in fields and by way-sides, and is sown in the winter and spring as a salad; and Sin. *Nigra*, Common Mustard, with smooth square pods, closely pressed to the stem, which is cultivated on account of its seeds, from which is obtained the mustard of the table.

Raphanus. *Gen. char.*—Cal. closed; pod round, twisted, jointed.

Raph. *Raphanistrum*, Wild Radish, or Jointed Charlock; with jointed, smooth, one-celled pods. Not uncommon among corn.

Raph. *Sativus*, Cultivated Radish; is a familiar plant in the kitchen garden.

Class XVI. Monadelphia.

The character of this class is derived from the stamens being united by their filaments into one tube; and the eight orders into which it is divided are distinguished by the number of stamens.

Order I. Triandria.

Tamarindus *Indica*, the Tamarind Tree; with one pistil; cal. four-parted; petals three; seeds contained in a pod; leaves pinnated, composed of sixteen or eighteen pairs of leaflets. This tree, which is a native of both the Indies, grows to a large size, and sends forth numerous branches, which are thickly set with a beautiful bright green foliage. The pulp, in which the seeds are imbedded within the pod, preserved with sugar, forms the well known acid substance, the tamarinds of the shops.

Sisyrinchium. *Gen. char.*—One pistil; two-leaved spathe; petals six, plain; caps. three-celled, inferior.

Sis. *Bermudiana*, Iris-leaved Sisyrinchium; with sword-shaped leaves; oblong, obcordate, veined petals. Native of Bermudas; and cultivated in the green-house in this country.

Sis. *Gramineum*, Grass-leaved Sisyrinchium; with broad, double edged stem; germen smooth. Native of Virginia, and a hardy perennial in the flower garden.

Ferraria. *Gen. char.*—One pistil; spathe three-leaved; no calyx; petals six, the three outermost broader; caps. three-celled, inferior.

Fer. *Tigridia*, Mexican Ferraria, or Tiger-flower; with folded leaves; corolla broad, pitcher-shaped, inner segments depressed, intersected. This plant, which is a native of Mexico and Peru, is conspicuous for the splendour and rich colouring of its flowers; but it is not less remarkable for its transient existence—all its beauties vanish in a few hours. *Bot. Mag.* xv. 532.

Fer. *Undulata*, Curled Ferraria; with many-flowered stem. A native of the Cape; and, though less splendid, yet it is equally singular and beautiful in its form and appearance, and not less fugacious in the duration of its flowers.

Order II. Pentandria.

Erodium. *Gen. char.*—Cal. five-leaved; cor. five-petaled; nectary five scales; fruit five-seeded, beaked.

Er. *Cicutarium*, Hemlock Stork's-bill; with many flowered peduncles and pinnated leaves, leaflets sessile, pinatifid, gashed; frequent in waste and sandy places.

Er. *Maritimum*, Sea Stork's-bill; with about three flowered peduncles; heart-shaped, gashed, crenated, rough leaves, depressed stems. Not uncommon in sandy places on the sea-coast.

Er. *Incarnatum*, Flesh-coloured Crane's-bill; with few flowered peduncles; leaves three-parted, ternate, or trifid, rough; stem shrubby. Native of the Cape, and one of the most beautiful ornaments of the green-house.

Order III. Heptandria.

Pelargonium. *Gen. char.*—Cal. five-parted, upper segment terminating the inner capillary, nectariferous tube; cor. five-petaled, irregular; fruit five-seeded, beaked.

Pel. *Pinnatum*, Pinnated Crane's-bill; without stem; umbels somewhat compound; leaves pinnated. Native of the Cape, and one of the tenderer species.

Pel. *Bicolor*, Two-coloured Crane's-bill; with many-flowered umbels, and leaves ternate, divided, lobed, and waved. This beautiful species is a fine ornament of the green-house.

Pel. *Peltatum*, Ivy-leaved Crane's-bill; with one-leaved calyx; leaves five-lobed, very entire, smooth; stem shrubby. Native of Africa.

Pel. *Incrassatum*, Fleshy-leaved Crane's-bill; nearly without stem, scape divided, rough; leaves lobed, pinnatifid, smooth. This species is tuberous-rooted, produces beautiful flowers, and is yet rare in this country.—*Bot. Mag.* xx. 761. and Plate 32. Fig. 8.

Order IV. Octandria.

Aitonia *Capensis*, Cape Aitonia. One style; cal. four-parted; cor. four-petaled; berry dry, quadrangular, one-celled, many-seeded. Native of the Cape, and cultivated in the green-house in this country.

Order V. Decandria.

Geranium. *Gen. char.*—Cal. five-leaved; cor. five-petaled; five nectariferous glands; fruit five-seeded, beaked; beaks bent backwards, naked.

Ger. *Robertianum*, Herb Robert, or Stinking Crane's-bill; with two flowered peduncles; pinnatifid, five-angular leaves; cal. with ten angles; caps. wrinkled. Very common in waste-places, and in hedges.

Ger. *Dissectum*, Jagged-leaved Crane's-bill; with two-flowered peduncles; petals notched; leaves divided into five segments; caps. rough; seeds reticulated: Not uncommon in waste places and gravelly soils.

Ger. *Sanguineum*, Bloody Crane's-bill; with one-flowered foot-stalks, five-parted, three-cleft, round leaves; caps. bristly at the summit. Among brushwood in mountainous rocky situations; and, with its deep red specious flowers, rivals some of the exotic species.

The three genera, *Erodium*, *Pelargonium*, and *Geranium*, were formerly included under the latter genus, till they were arranged according to the characters given of each by the celebrated French botanist L'Heritier.

Order VIII. Polyandria.

Bombax *Ceiba*, Cotton Tree. One pistil; cal. simple; caps. five-celled, many-seeded; style undivided; seeds woolly; leaves digitate, with five segments. Native of Jamaica, and one of the largest trees of that island, sometimes rising to the height of 100 feet; the wood is light and porous, and answers well for canoes.

Gossypium *Barbadense*, Cotton Tree. One pistil; cal. exterior, three-cleft; three or four-celled; seeds numerous, imbedded in cotton.

This remarkable plant, which furnishes such abundance of materials for manufactures and commerce, is the spontaneous production of all the tropical regions of Asia, Africa, and America. Different kinds or varieties of cotton are cultivated in the West Indies. Two kinds are particularly distinguished by the planters under the names of *green-seed cotton* and *shrub cotton*; the first is only cultivated for domestic purposes, because it is difficult to separate the seeds from the wool. Several varieties of shrub cotton are described, some of them, perhaps, arising from diversity of soil and culture; such are the common Jamaica cotton, with oblong smooth seeds, and of a strong coarse staple; brown bearded, more productive, and of a finer staple; Nankeen, similar to the preceding, excepting the colour of the wool; French, or small-seed, usually cultivated in St Domingo; and Kidney cotton, so called from the seeds adhering to each other in the pod, and supposed to be the true Brazil cotton.

A valuable kind of cotton, called the Bourbon cotton, was introduced into Jamaica from Bengal in 1795; it is very productive, bears the driest weather, and parts freely from the seed.

The cotton plant, as it is cultivated in Jamaica, is raised from the seed, which is sown from April to October in rows from six to eight feet distant, and the seeds in the row four feet apart. The plants appear in a fortnight, and at the end of three or four months they are pruned or topped, and if the crop be luxuriant the same operation is repeated a second, and even a third time. At the end of five months the beautiful yellow flowers begin to expand; in two months more the pods are formed; and from the seventh to the tenth month they ripen in succession, when they burst open in three partitions, and display the white and glossy down; the wool is then gathered and passed through the *gin*, a machine composed of two small rollers, turning in opposite directions for the purpose of separating the seeds; the wool is afterwards hand-picked to clear it of decayed leaves, broken seeds, and any portions that are stained and damaged in the pod; and being packed in bags of about 200 lb. weight, is ready for the market. The produce of an acre is estimated at from L.200 to L.300, but the crop is very precarious, from numerous accidents to which the plant is exposed. In the first stage of its growth it is attacked by the grub; devoured by the caterpillar in the second; withered by the blast, or destroyed by rains, both in the flowering and ripening state.

Malva. *Gen. char.*—Cal. double, exterior, about three-leaved; caps. numerous, one-seeded, arranged circularly.

Mal. *Sylvestris*, Common Mallow; with herbaceous, erect stem; seven-lobbed, acute leaves; foot-stalks of leaves and flowers hairy. Common in waste places, by way-sides and hedges.

Mal. *Rotundifolia*, Dwarf Mallow; with leaves heart-shaped, round, five or seven lobed; common in waste places and by way-sides.

Mal. *Moschata*, Musk Mallow; with radical leaves kidney-shaped, gashed; stem-leaves five parted; leaflets much divided; calyx hairy. On the borders of fields, but less frequent.

Lavatera. *Gen. char.*—Cal. double, exterior, three cleft; caps. numerous, one-seeded, arranged circularly.

Lav. *Arborea*, Sea-tree Mallow; with woody stem, leaves with seven angles, woolly, and folded. On rocky places near the sea, but rare; on the Bass island and in the frith of Forth, and on Portland island in the British channel. A biennial plant, and grows to the height of six feet.

Lav. *Trimestris*, Annual Lavatera; with rough herbaceous stem, smooth leaves, and one-flowered footstalks; is the well known and shewy annual of the flower garden, where it frequently varies with white flowers.

Hibiscus. *Gen. char.*—Calyx double, exterior, many-leaved; caps. five-celled, many-seeded.

Hib. *Syriacus*, better known by the name of *Althæa Frutex*, is a native of Syria, and one of the finest autumnal ornaments of the flower-garden.

Hibisc. *Elatus*, Mountain Mahoe; with heart-shaped, roundish, entire leaves; one-flowered, very short footstalks; calyx ten-toothed. Frequent in the woods of Jamaica, grows to a large tree, sometimes 60 feet high, and produces specious yellow flowers from the extremities of the branches, from which it has been called tulip tree. The wood is suitable for many valuable purposes, and the bark furnishes an excellent material for ropes. It varies sometimes with red flowers.

Hibisc. *Esculentus*, Eatable Hibiscus, or Ochra of the West Indies; with leaves five-parted, pedate; inner calyx bursting at the side. The capsules of this plant, which are very succulent, are an ingredient in the celebrated pepper-pot, or are eaten by themselves at table, and constitute a rich nourishing food.

Hibisc. *Subdariffa*, Indian Sorrel; with serrated leaves, upper seven parted, lower ovate, undivided. Cultivated in Jamaica on account of the calyx and capsules, which have an agreeable acid taste, and are made into tarts, stewed with milk, or formed into syrup.

Camellia. With imbricated, many-leaved calyx, interior leaflets larger; of which Cam. *Japonica*, or Japan Rose, varying with red and white, single and double flowers, becomes a large tree in the groves and gardens of Japan, and is one of the most splendid inmates of the stove and conservatory in this country,—and *Alcea*, the Holly-hock, with calyx double, the exterior six or nine-cleft, caps. numerous, one-seeded, the varieties of which, with single and double flowers, constitute the shewy ornament of the garden and shrubbery towards the close of summer.

Class XVII. Diadelphia.

The character of this class is derived from the division of the stamens into two parcels. It contains four orders, which are distinguished by the number of their stamens; and the flowers are almost universally papilionaceous.

Under the first order, Pentandria, a single genus, *Monnieria*, a South American plant, with gaping corolla and alternate leaves, is placed.

Order II. Hexandria.

Fumaria. *Gen. char.*—Cal. two-leaved; cor. gaping; filaments two, membranaceous, each with three anthers.

Fum. *Officinalis*, Common Fumitory; with loose spikes, one-seeded, globular, notched pods, segments of the leaflets dilated; very common in fields and gardens.

Order III. Octandria.

Polygala. *Gen. char.*—Cal. five-leaved, two largest leaflets wing-shaped, coloured; pod heart-shaped, two-celled.

Pol. *Vulgaris*, Milk Wort; with flowers crested and in racemes; and leaves linear, lanceolate. Common in warm dry pastures; and its beautiful flowers are blue, violet, and white. To the same genus belong some beautiful species from America and the Cape of Good Hope.

Order IV. Decandria.

In this order the stamens are usually divided into nine in one parcel, with a single one separate, and the genera are distributed into six sections, in the first of which the stamens are all united, as in the common broom; in the second the stigma is downy, as in *Pisum* or Pea, and *Vicia* or Vetch; in the third the pod is nearly two-celled, as in *Astragalus* or Milk-vetch; in the fourth the pod has scarcely more than one seed, as in *Trefolium* or Trefoil; in the fifth the pod is nearly jointed, as in *Hedysarum*; and in the sixth the pod is one-celled and many-seeded.

Spartium *Scoparium*, Common Broom; stigma longitudinal, villous above; filaments united, adhering to the germen; cal. produced downwards; leaves ternate and solitary; branches angular and unarmed. Frequent in dry pastures.

Ulex *Europæus*, Common Furze or Whin. Cal. two-leaved; pod scarcely longer than the calyx; all the stamens united. *Spec. char.*—Teeth of the cal. obtuse; bracteas ovate, loose; branches erect. In barren and heathy soils frequent.

Hedysarum. *Gen. char.*—Pod with one-seeded joints; keel of the cor. transversely obtuse.

Hed. *Onobrychis*, Saint Foin; with pinnated leaves; pods one-seeded; hairy wings of the corolla of the length of the calyx. On hills and chalky pastures in England, and frequently cultivated as food for domestic animals.

Hed. *Gyrans*, Moving Plant; with ternate leaves. A native of the interior parts of Bengal, and remarkable for the constant motion or alternate meeting and receding of the two small appendages or leaflets on each side of the footstalks. This singular motion is continued through the whole day in its native soil; but it is only in the middle of the day that it exerts this power in the stove in this country. Plate 32. Fig. 9.

To this order belong *Lupinus*, Lupine, with the anthers alternately round and oblong, and legume or pod leathery; *Pisum*, in which the style is keeled and woolly above; and of which *Pisum Sativum*, the Garden Pea, furnishes a good example.

Phaseolus, the Kidney Bean; with the keel and style spiral.

Lathyrus; with style plain and woolly above, and upper segments of the calyx one half shorter, of which Lath. *Odoratus*, Sweet Pea, or Painted Lady Pea, is one of the most shewy and common annuals in the flower garden;

Vicia; of which the garden bean, *Vicia Faba*, is a species; with the style bearded under the stigma.

Trifolium, or Trefoil, in which the pod is one or two-seeded, and scarcely longer than the calyx, and the flowers grow in heads.

Indigofera, in which the keel has a tooth on each side, and different species of which are cultivated in the East and West Indies for the purpose of extracting the indigo of commerce; and

Cytisus, with two-lobed calyx, and pod on a footstalk, of which *Cyt. Laburnum*, Common Laburnum, is a well known ornament of the shrubbery.

Class XVIII. Polyadelphia.

In this class the stamens are united by their filaments into more than two parcels; and the three orders into which it is divided are distinguished by the number or insertion of the stamens.

Order I. Dodecandria.

Theobroma *Cacao*, Chocolate-nut Tree. Cal. three-leaved; cor. five-petaled; nectaries five; the number of stamens not distinctly ascertained. The chocolate tree grows to the height of 12 or 16 feet; "it is carefully cultivated," says Dr Wright, "in all the French and Spanish islands in the warmer parts of America. This was formerly the case also in Jamaica; but at present we have only a few straggling trees left as monuments of our indolence. This tree delights in shady places and deep vallies. The leaves are oblong, large, and pointed; the flowers, which are small and pale red, spring from the trunk and large branches; and the pods are oval and pointed. The seeds or nuts are numerous, and curiously enclosed in a white pithy substance. The cacao-nuts being gently parched in an iron pot over the fire, the external covering easily separates; the kernel is levigated on a smooth stone, a little annotto is added, and with a few drops of water is reduced to a mass, and formed into rolls of one lb. weight each. This simple preparation is the most natural and the best." But it ought to be added that the chocolate of the shops is composed of various other ingredients, and perhaps, in some cases, contains but a small proportion of the real powder of the cacao-nut. Plate 33. Fig. 1.

Monsonia *Speciosa*, Large-flowered Monsonia; with five-leaved calyx; cor. five-petaled; stamens 15, united in five divisions; style five-cleft; caps. five-seeded; leaves in fives, and leaflets twice pinnated. This splendid species is a native of the Cape, and may be treated as a hardy green-house plant.

Citrus. *Gen. char.*—Cal. five-toothed; cor. five-petaled; stamens twenty, united into a cylinder; pistil one; berry celled, with a vesicular pulp.

This genus was placed under the following order, Icosandria; but as the filaments are not inserted into the calyx, it belongs more properly, as Dr Smith remarks, to this order.

To this genus belong Cit. *Medica*, the Citron, the rind of which, and the young fruit, are prepared as a sweet-meat; Cit. *Aurantium*, the Orange, of which two varieties, the China and Seville, or the *sweet* and the *bitter*, are well known; Cit. *Decumana*, the Shaddock, which produces a fruit equal in size to a man's head, and eaten, like olives, to give a zest to wine,---and of which the forbidden fruit, as it is called in Jamaica, is supposed to be a variety. To these may be added lime and lemon trees, accounted by some as varieties, but, from the diversity of their appearance and fruit, might be properly regarded as different species.

Order II. Icosandria.

In this order the stamens are numerous, and their filaments are inserted into the calyx.

Melaleuca. *Gen. char.*—Cal. five-parted, superior; cor. five-petaled; caps. half covered with a berried calyx. Of this splendid tribe of plants, which are remarkable for the length and rich colours of the filaments, several species are successfully cultivated in the conservatories of this country; they are chiefly natives of New Holland.

Mel. *Leucadendron*, the Cajeput Tree; the dried leaves of which afford, by distillation, an essential oil used in medicine, is a native of mountainous places in Amboyna.

Order III. Polyandria.

In this order the stamens are unconnected with the calyx.

Hypericum. *Gen. char.*—Cal. five-parted, inferior; petals five; filaments in three or five divisions, united at the base; caps. many-seeded.

Hyp. *Androsæmum*, Tutsan or Park Leaves; with flowers having three pistils; berried capsules, and double-edged shrubby stem; not uncommon in woods, and with its large yellow flowers is a conspicuous ornament in the garden.

Hyp. *Quadrangulum*, Square St John's Wort; is frequent on the banks of rivers and moist meadows, where it is easily distinguished by its specific character; and Hyp. *Perforatum*, Perforated St John's Wort, is common in hedges and woods, and is distinguished by its double-edged stem and obtuse leaves, marked with pellucid spots.

Class XIX. Syngenesia.

In this class the anthers are united into a tube, and the flowers are compound; that is, each flower consists of a number of small flowers called florets. The structure of the florets varies in different plants; sometimes each floret is furnished with perfect stamens and pistil, and brings its seed to maturity; sometimes the florets of the disk are perfect or united, while those of the margin have pistils only, but they all produce perfect seed; sometimes the florets of the disk are perfect or united, but those of the margins have neither pistils nor stamens; in other cases the florets of the disk have stamens only, and those of the margin have pistils only; and in others, several flowers, either simple or compound, but with united tubular anthers, and with a partial calyx, are all included in one general calyx. These differences are the foundation of the five orders of this class.

Order I. Polygamia Æqualis.

The character of this order is derived from each floret having perfect stamens and pistil, and producing ripe seed. Some other differences in the structure of the florets give rise to the distribution of the genera of this order into three sections. Under the first section are included those which have the florets all ligulate or strap-shaped, and which are denominated by Tournefort, semiflosculous; their flowers are generally yellow, sometimes blue, and rarely reddish; they expand in a morning, and close towards noon, or in cloudy weather; and their herbage, when bruised, affords a bitter milky fluid. Of this section common dandelion, goats'-beard, and hawk-weed, are good examples. In the second section the flowers are globose, or grow in heads, and the florets are all tubular, five-cleft, and spreading, as in *Carduus*, Thistle, and *Arctium*, Burdock. In the third section the flowers are discoid, the florets are all tubular and regular, forming a flat or conical surface, as in *Bidens*, Bur Marygold, and *Santolina*, Sea-cotton Weed.

Leontodon. *Gen. char.*—Receptacle naked; cal. imbricated, down, simple, on foot-stalks.

Leon. *Taraxacum*, Common Dandelion; with the exterior scales of the calyx reflected, leaves runcinated, toothed, smooth; very common in meadows, pastures, and waste places.

Leon. *Palustre*, Marsh Dandelion; with leaves sinuated, and sometimes slightly downy; in moist meadows and marshy places.

Hieracium. *Gen. char.*—Recept. naked, dotted; cal. imbricate, ovate; down, simple, sessile.

Hier. *Pilosella*, Mouse-ear Hawkweed; with elliptical entire leaves, woolly underneath, creeping runners, and one-flowered naked stem; very common in dry pastures.

Hier. *Subaudum*, Shrubby Broad-leaved Hawkweed; with many-flowered erect stem, and ovate lanceolate leaves. In woods and rough stoney places.

Arctium *Lappa*, Burdock. Cal. globular, scales bent inwards, and hooked at the summit; leaves heart-shaped, unarmed, and on foot-stalks. Very common by way-sides and in waste places.

Carduus. *Gen. char.*—Cal. inflated, imbricated, with spinous scales; recept. hairy, down falling off.

Car. *Lanceolatus*, Spear Thistle; with decurrent, pinnatifid, rough leaves, segments divaricate, or alternately pointing in different directions. Common in waste places and by way-sides.

Car. *Arvensis*, Creeping Thistle; with sessile, pinnatifid, spinous leaves, stem paniculated; cal. ovate, furnished with spines, down feathery. Very common in fields and by way-sides.

Car. *Marianus*, Milk Thistle; with leaves embracing the stem, spinous, radical, leaves pinnatifid; scales of the calyx leafy, prickly on the margin. In waste places, where it is easily known by its fine green leaves, beautifully marked with white veins.

Eupatorium *Cannabinum*, Hemp Agrimony; recept. naked, down rough; cal. imbricated, oblong; style half two-cleft, protruded; leaves digitate. In wet places on the banks of rivers.

Order II. Polygamia Superflua.

The genera belonging to this order are divided into three sections; discoid, or without strap-shaped florets; florets half tubular, and nearly two-lipped; and radiate flowers. To the first section belong *Tanacetum*, Tansey; *Artemisia*, Wormwood; and *Gnaphalium*, Cudweed: To the second, *Perdicium*, a rare foreign genus, which is the only example: And the following having radiant flowers, or the marginal floret strap-shaped, come under the third section.

Bellis *Perennis*, Common Daisy; recept. naked, conical; no down; cal. hemispherical, with equal scales; seeds obovate; flower-stem naked; root creeping. Very common in meadows and pastures.

Chrysanthemum. *Gen. char.*—Recept. naked, no down; cal. hemispherical, imbricated, with scales dilated at the margin, and membranaceous.

Chrys. *Leucanthemum*, Great White Ox-eye; with leaves embracing the stem; oblong, obtuse, gashed, pinnatifid at the base; radical leaves obovate, and on footstalks. Common in fields and pastures, and is easily distinguished by its specious white flowers.

Chrys. *Segetum*, Yellow Ox-eye, or Corn Marygold; with stem embracing leaves, divided into segments above, toothed at the base; common among corn, especially in a sandy soil. The corn fields in Scotland were at one time so overrun with this plant, that laws were enacted obliging the inhabitants to eradicate it from their grounds, and penalties were inflicted on those who neglected it. Similar regulations were established in Denmark.

Chrys. *Indicum*, Indian Ox-eye Daisy; with simple ovate, sinuated, angular, serrated leaves. This beautiful species, which is much cultivated in China and Japan, is highly ornamental to the green-house and parlour in the winter season, when it shews its fine double, tubular, or quilled flowers, and is not less admired for the fragrance of its leaves.

Chrys. *Tricolor*, Three-coloured Ox-eye Daisy; with double pinnatifid leaves; leaflets linear, distant, bent backward; stem branching, erect. Supposed to be a native of Barbary, and introduced into Britain in 1798, and is an annual of easy culture. Plate 33. Fig 2.

To this order belong *Solidago*, Golden-rod; *Senecio*, Groundsel; *Tussilago*, Colt's foot; *Aster*, Starwort; *Anthemis*, Camomile; and *Achillea*, Sneezewort; different species of which are indigenous, and most of them common.

Gynandria.

ORDER III. POLYGAMIA FRUSTRANEA.

In this order the florets of the disk are perfect or united, and those of the margin have neither pistils nor stamens.

CENTAUREA. *Gen. char.*—Recept. bristly, down simple; rays funnel-shaped, longer than those of the disk, and irregular.

Cent. *Nigra*, Black or Lesser Knapweed; with the scales of the calyx ovate, and with erect capillary cilia; lower leaves lyre-shaped, angular; upper leaves ovate. Common in pastures and by way-sides.

Cent. *Cyanus*, Corn Blue-bottle; with the scales of the calyx serrated; leaves linear, entire; lower leaves toothed. Common among corn.

RUDBECKIA. *Gen. char.*—Recept. chaffy, conical; down with a four-toothed margin; cal. with a double series of scales.

Rud. *Purpurea*, Purple Rudbeckia; with lanceolate-ovate leaves, alternate, undivided, and petals of the ray two-cleft. Native of Carolina and Virginia, but cultivated in the open ground in this country. Plate 33. Fig. 3.

HELIANTHUS. *Gen. char.*—Recept. chaffy; down awned; cal. ragged.

Hel. *Multiflorus*, Many-flowered Sun-flower; with inferior leaves heart-shaped, three-nerved; upper leaves ovate. Native of North America, and a hardy perennial in the gardens of this country.

Hel. *Annuus*, Common Sun-flower; is a well known and shewy annual in every garden; and Hel. *Tuberosus*, Jerusalem Artichoke, is sometimes cultivated for the sake of its tuberous roots, which are eaten like potatoes.

ORDER IV. POLYGAMIA NECESSARIA.

In this order the florets of the disk have only stamens, and those of the margin have pistils only.

CALENDULA *Officinalis*, Garden Marygold, in which the receptacle is naked, there is no down, and the seeds are membranaceous, is an example of this order.

ORDER V. POLYGAMIA SEGREGATA.

In this order, several flowers, either simple or compound, but with united tubular anthers and a partial calyx, are included in a general calyx.

ECHINOPS *Ritro*, Small Globe Thistle; perianth one-flowered; recept. bristly; down obsolete; head globular; leaves pinnatifid, smooth on the upper surface. Native of Siberia and Southern Europe, but has been long cultivated in the gardens of Britain. Plate 33. Fig. 4.

CLASS XX. GYNANDRIA.

In this class the stamens are inserted either upon the style or germen. Linnæus divided the class into nine orders, the character of which is taken from the number of stamens; but succeeding botanists have abolished some of these orders, and some have abolished the whole class, and referred the plants included under it to other classes. Without going over the whole of the orders, a few examples will be sufficient to illustrate the class.

Gynandria.

ORDER I. DIANDRIA.

ORCHIS. *Gen. char.*—Nectary horn-shaped, placed behind the flower.

Or. *Bifolia*, Butterfly Orchis; with undivided bulbs; lip of the nectary lanceolate, entire; horn very long, and lateral petals spreading. In woods and moist places, with a clay soil.

Or. *Maculata*, Spotted Orchis; with palmated, divaricate roots; horn of the nectary shorter than the germen; lip three-lobed, plain; petals spreading. Common in moist meadows and pastures.

OPHRYS. *Gen. char.*—Nectary slightly keel-shaped underneath, deflected.

Oph. *Ovata*, Common Twayblade; with fibrous roots; two-leaved stem; leaves elliptical; lip of the nectary linear, two-cleft. In woods, meadows, and pastures.

Oph. *Corallorhiza*, Coral-rooted Ophrys; with branching, winding, divaricate roots; stem sheathed, without leaves; lip of the nectary undivided. A rare plant, observed by Lightfoot in Ross-shire, and lately discovered near Ravelrig, five miles from Edinburgh.

CYPRIPEDIUM. *Gen. char.*—Nectary two-lipped, lower lip ventricose, inflated, hollow.

Cyp. *Calceolus*, Ladies Slipper; with fibrous roots; leafy stem; petals four, lanceolate, pointed; upper lip elliptical, channelled. In woody places in the north of England, but rare.

Cyp. *Parviflorum*, Yellow Ladies Slipper; with lateral petals, linear, twisted, and longer than the nectary, which is without veins. Native of North America. See Plate 33. Fig. 5.

LIMODORUM. *Gen. char.*—Nectary one-leaved, concave, raised on a footstalk within the lowest petal.

Lim. *Tuberosum*, Tuberous-rooted Limodorum; with bearded, thin, spiked flowers. Native of marshy places in South Carolina; was accidentally introduced into England in 1788, along with bog-earth brought over with some plants of Venus fly-trap. The roots of limodorum were discovered by Mr James Smith, a zealous and excellent botanist, at that time gardener to Mr Curtis, now nurseryman at Monkwood in Ayrshire.

Lim. *Altum*, Tall Limodorum, or Jamaica Saloup; with beardless flowers, and spike in the form of a panicle. Native of Jamaica, where it grows in the cooler parts of the mountains. Two other species are natives of the same island.

EPIDENDRUM. *Gen. char.*—Nectary waved, oblique, reflected.

Epi. *Sinense*, Chinese Epidendrum; with sword-shaped, striated, radical leaves; petals nearly equal; nectary bent-back, spotted; and bractea a little shorter than the germen. Native of China, and cultivated in the stove in this country. Plate 33. Fig. 6.

Epi. *Vanilla*, Vanilla; leaves ovate, oblong, nerved, sessile; tendrils spiral. Native of Jamaica, and cultivated on account of the seeds, which have an agreeable aromatic odour, and are employed to give a flavour to chocolate, and as a perfume to snuff and other substances. Many other species of the same genus are natives of Jamaica.

Order III. Tetrandria.

Nepenthes *Distillatoria*; one pistil; cal. four-parted; no corolla; caps. four-celled. This singular plant, a native of Ceylon, is remarkable for the peculiar structure of its leaves, each of which terminate in a kind of close shut tube, like a tankard, and is furnished with a lid or covering, which contains water, supposed to be secreted through the footstalk. Small worms and insects are found dead in the tube; and a little animal like a shrimp, which is met with alive, is supposed to feed on them.

Order IV. Pentandria.

Passiflora. *Gen. char.*—Three pistils; cal. five-parted; cor. five-petaled; nectary in the form of a crown; berry on a footstalk.

Pass. *Cærulea*, Common Passion-flower; with entire, palmated leaves. Native of the Brazils, and cultivated in the green-house in this country.

Pass. *Alata*, Winged Passion-flower; with undivided entire leaves; membranaceous square stem. Native of the West Indies, and cultivated in the stove on account of the beauty of its flowers.

Pass. *Serratifolia*, Notched-leaved Passion-flower; with undivided, ovate, serrated leaves. Native of Surinam, and has been admitted into the stove, for the sake both of the beauty and fragrance of its flowers. Plate 33. Fig. 7.

Pass. *Quadrangularis*, Four-angled Passion-flower, or Granadilla; leaves oval, subcordate, smooth; stem square, membranaceous. Native of Jamaica, and one of the largest and most beautiful of this splendid tribe of plants. It is cultivated in that island, both on account of its excellent fruit, which contains a rich pulp, with an agreeable odour and pleasant acid taste, and for forming arbours, for which it is well calculated by its thick foliage and highly ornamental flowers.

Pass. *Maliformis*, Apple-formed Passion-flower, or Water Lemon, the fruit of which furnishes food to the wild hogs; and Pass. *Murucuja*, Bull-hoof, the flowers of which, infused in wine or spirits, are employed as a narcotic,---are also natives of Jamaica.

Class XXI. Monœcia.

In this class the stamens and pistils are in separate flowers, but both grow on the same plant. The characters of the orders are taken from the number of stamens, the connection of the filaments, or of the anthers, and their insertion on the style or germen. In describing the genera belonging to this class, as there are two sets of flowers, the one bearing stamens and the other pistils, separate descriptions are necessary. The first or the flowers with stamens are denoted by (1), and the flowers with pistils by (2).

Monandria.

Zannichellia. (1) Cal. none, cor. none. (2) Cal. one-leafed, cor. none, pistils four, seeds four.

Zan. *Palustris*, Horned Pond-weed; with square-celled anther, and stigmas very entire. Native of Britain, and found in ditches and pools.

Artocarpus, Bread-fruit Tree. (1) Cal. two-valved, cor none. (2) Cal. none, cor. none, one style; drupe many-celled.

Art. *Incisa*; Notch-leaved; with gashed leaves; is the celebrated bread-fruit tree; a native of Otaheite and other South-sea islands, which was introduced into Jamaica in the year 1793. Three hundred trees were brought from Otaheite by captain Bligh in the ship Providence, and distributed to different places, from which they have spread to every part of the island.

When the fruit of this tree is used as bread, it is collected before it is quite ripe, roasted in an oven, and the rind being scraped off, the inside, which is soft and white, is eaten, and is found to be a nutritious substance.

The bread-fruit tree was alluded to by Dampier, lord Anson, captain Cook, and other voyagers, as a production of the Ladrone and Philippine islands, and of Otaheite and some of the neighbouring islands; and from the opinion that was formed of its valuable qualities, the Bounty, commanded by captain Bligh, was dispatched by the British government in 1787 to collect plants to be transported to the colonies in the West Indies. A mutiny of the crew, who seized the ship, and carried it back to Otaheite, frustrated for a time this beneficial scheme; and it was not till 1793, as already alluded to, that the plan was successfully accomplished.

Several varieties of the bread-fruit tree are known in its native soil; and another species, with entire leaves, was also introduced at the same time with the first into Jamaica, and is now very generally cultivated in that island.

Diandria.

Lemna. *Gen. char.*—(1) One-leafed, cor. none. (2) Cal. one-leafed, cor. none; style one; caps. many-seeded.

Lem. *Trisulca*, Ivy-leaved Duckweed; with lanceolate proliferous leaves, on footstalks. In ditches and pools.

Lem. *Minor*, Lesser Duckweed; with sessile leaves, plain on both sides, and solitary roots. Very common in ditches and in pools.

Triandria.

Sparganium. *Gen. char.*—(1) Cal. three-leaved, cor. none. (2) Cal. three-leaved; drupe dry, one-seeded.

Spar. *Ramosum*, Branched Bur-reed; with leaves three-cornered at the base, concave at the sides; common peduncle branched; stigma linear. Frequent in lakes and on the banks of rivers.

Spar. *Simplex*, Unbranched Upright Bur-reed; with leaves triangular at the base, plain at the sides, and the common peduncle simple. In lakes.

Carex. (1) An imbricated catkin, cal. one-valved glume; cor. none. (2) Imbricated catkin; cal. one-valved glume; cor. none; stigmas two or three; seed inclosed in an inflated coat.

Car. *Ovalis*, Oval-spiked Carex; with about six oval spikes, alternately approaching; glumes lance-shaped, equal to the seed-coat. In marshes and moist meadows.

Car. *Remota*, Remote Carex; with single distant, nearly sessile spikes; bracteas very long, exceeding the stem; seed-coat nearly entire. In moist woods and wet shady ditches.

Car. *Arenaria*, Sea-Carex; with the spikelets crowded; bracteas scaly; stem triangular; leaves plain. Abundant in sandy places near the shore.

Car. *Sylvatica*, Pendulous Wood-Carex; with sheaths one-half shorter than the peduncle; spikes thread-shaped, loose, nodding; fruit ovate, triangular, beaked. Frequent in woods; rises to the height of two or three feet, and is furnished with an upright, leafy, smooth, triangular stem.

Car. *Flava*, Yellow Carex; with shortened sheaths nearly equal to the peduncle; spikes producing pistils, roundish; fruit beaked, deflected, stem smooth. Frequent in marshy places.

Car. *Præcox*, Vernal Carex; with shortened sheaths nearly equal to the peduncle; spikes ovate, approaching; glumes slightly dagger-shaped; fruit roundish, woolly. Common on heaths and dry pastures.

Car. *Pilulifera*, Round-headed Carex; without sheaths; spikes with pistils, sessile, crowded, roundish; glumes slightly dagger-shaped; fruit roundish, hairy. Frequent in pastures and heaths.

Of this extensive genus, fifty-two species are elegantly described in the *Flora Britannica*. The attentive study of these descriptions, and the careful comparison with the living specimens, cannot fail to improve the learned botanist in the knowledge of the discriminating characters of this curious tribe of plants.

Typha. *Gen. char.*---(1) Catkin cylindrical; anthers about three on a common filament. (2) Catkin cylindrical; seed one, with a downy footstalk.

Typha *Latifolia*, Great Cat's-tail, or Reed-mace; with the leaves nearly sword-shaped, and spikes producing anthers and pistils, approaching each other. Not uncommon in lakes and ditches.

Typha *Angustifolia*, Lesser Cat's-tail, or Reed-mace; with leaves semi-cylindrical, plain, equal to the stem; the anther and pistil bearing spike distant. In ditches and lakes, but less frequent. In the middle of Woolwich common.

Hernandia. *Gen. char.*—(1) Cal. three-parted; cor. three-petaled. (2) Cal. truncated; cor. six-petaled; drupe hollow.

Hern. *Sonora*, Whistling Jack-in-a-box; with heart-shaped, peltate leaves. Native of the East and West Indies. A lofty tree, and remarkable for the singular structure of the fruit. The external covering is much larger than the contained seed; and through a small opening the wind being freely admitted, when it blows strong, the reverberated sound produced within the hollow capsule is heard at a great distance, and is sometimes alarming to travellers.

From this sonorous whistling noise, the trivial name of Jack-in-a-box is derived.

Tetrandria.

Urtica. (1) Cal. four-leaved; cor. none; rudiment of the germen cup-formed. (2) Cal. two-leaved; cor. none; seed one, superior, shining.

Urt. *Urens*, Small Nettle; with opposite elliptical, about five-nerved leaves; racemes nearly simple. Very common in cultivated places.

Urt. *Dioica*, Great Nettle; with leaves opposite, heart-shaped, racemes much branched, double, flowers sometimes diœcious. Common in waste places and hedges.

Buxus. *Gen. char.*—(1) Cal. three-leaved, petals two, with the rudiment of a germen. (2) Cal. four-leaved, petals three, styles three, caps. three-beaked, three-celled.

Bux. *Sempervirens*, Box-tree; on some of the chalk hills in England, and well known, as it is employed as edgings of borders, for which it is well fitted by its evergreen leaves. The close texture of the wood, and the fine polish of which it is susceptible, render its use extensive for the purpose of turnery.

Betula. *Gen. char.*—(1) Cal. scale of the catkin one-leafed, three-cleft, three-flowered; cor. four-parted. (2) Cal. scale of the catkin one-leafed, nearly three-cleft, two-flowered; styles two, seeds compressed.

Bet. *Alba*, Common Birch; with ovate-pointed, serrated, smoothish leaves; common in woods. In the beautiful variety with pendulous branches, from which it is called the weeping birch, the leaves are quite smooth.

Bet. *Nana*, Dwarf Birch; with notched roundish leaves; native of elevated marshy places in Scotland, and rises only to the height of three feet.

Bet. *Alnus*, Common Alder; with branching peduncles, leaves roundish, wedge-shaped, serrated, viscid; common in marshy places.

Morus. *Gen. char.*—(1) Cal. four-parted; cor. none. (2) Cal. four-leaved; cor. none; styles two, seed one, berried.

Mor. *Tinctoria*, Fustic-tree; with oblong leaves, lengthened on one side, and axillary spines. Native of Jamaica, and remarkable for its quick growth, rising to the height of 30 or 40 feet in eight or ten years; the timber is of an excellent quality, and it furnishes the valuable dye-stuff, fustic.

Mor. *Alba*, White Mulberry; a native of China, is extensively cultivated for the sake of its leaves as food for silkworms; grows in Britain.

Mor. *Rubra*, Red Mulberry, a native of Virginia, is cultivated for the same purpose; Mor. *Nigra*, Black Mulberry, is a native of Persia, with dark red fruit, from which wine is made; and Mor. *Papyri-*

fera, Paper Mulberry, a native of Japan and the South sea islands, affords materials for paper and cloth from its bark.

Pentandria.

Amaranthus. *Gen. char.*—(1) Proper calyx three-leaved; cor. none; stamens from three to five. (2) Proper calyx three-leaved; cor. none; styles three; caps. one-celled, cut round; seed one.

Am. *Blitum*, Wild Amaranth; with lateral heads; flowers three-cleft, triandrous; leaves ovate, stem spreading. In cultivated places in some parts of England.

Am. *Spinosus*, Prickly Calalue; with compound terminal racemes, and short prickles under the leaves; a common plant in Jamaica, and frequently employed as a wholesome and agreeable vegetable.

Polyandria.

Fagus. *Gen. char.*—(1) Cal. bell-shaped, five-cleft; cor. none; stamens from five to twelve. (2) Cal. four-cleft; cor. none; styles two or three, three-cleft; seeds two or three, covered with a leathery muricated calyx.

Fag. *Castanea*, Chesnut-tree; with lance-shaped, sharp-pointed, serrated leaves; and the prickles of the fruit compound, interwoven. In woods in England; sometimes grows to a very large size; and a tree in Gloucestershire is supposed to be more than a thousand years old.

Fag. *Sylvatica*, Beech-tree; with leaves ovate and indistinctly serrated; common in woods and hedges, and well known for its use as a close fence.

Quercus. *Gen. char.*—(1) Cal. bell-shaped, lobed; cor. none; stamens from five to ten. (2) Cal. bell-shaped, entire, rough; cor. none; style one; stigmas three; nut superior, leathery, one-seeded.

Quer. *Robur*, Common British Oak; with deciduous, oblong, indented leaves, broader at the summit, indentations acute, lobes obtuse, and peduncles lengthened; common in woods.

The oak in a favourable situation attains a prodigious size. The trunk of an oak in Shropshire, mentioned by Lightfoot, measured in circumference 68 feet, or nearly 23 feet in diameter; and another in Yorkshire measured 48 feet in circumference, or 16 feet in diameter.

Various other species of oak are natives of the south of Europe and of North America.

Quer. *Suber*, grows abundantly in Italy, the south of France, Spain, and Portugal, and furnishes the well known substance cork, of so much importance in domestic economy. The cork-tree is an evergreen, with ovate, oblong, undivided, serrated leaves, slightly downy underneath. Cork is a singular substance, which is produced on the cuticle. The trees are barked for the first time before they are 20 years old, but the best cork is obtained from the oldest trees; and after every peeling the succeeding bark is of a better quality. They are generally peeled once in eight or ten years, and this operation so far from being injurious, contributes to their growth and vigour; for it is observed that those trees which are not stripped of the bark, in a few years begin to decay, and in the course of 50 or 60 years a whole plantation is destroyed; but those trees that are regularly barked, live and thrive more than 200 years.

When the cork is stripped off, an exudation of a reddish brown colour immediately takes place; and of the excreted matter, as it acquires consistency by the action of the air, the succeeding layer of cork is formed. The uses of cork are too familiar to require enumeration.

Quer. *Cerris*, Gall Oak; with smooth, oval, serrated leaves. This tree, which is a native of Asia Minor, from the Bosphorus to Syria, and from the shores of the Archipelago to the frontiers of Persia, seldom attains the height of more than six feet, and more frequently appears in the form of a shrub. The galls are produced on the shoots of the young branches, and the best are those which are collected before the escape of the insect to which their production is owing. Those which are perforated are less fit for the purpose of dye-stuff, and are known in commerce by the name of white galls; but the black or green galls are heavier, and therefore more valuable.

Juglans. *Gen. char.*—(1) Catkin imbricated; cor. six-cleft; stamens about 18. (2) Cal. four-cleft; cor. four-petaled; styles two, drupe leathery.

Jug. *Regia*, Walnut-tree; with alternate, oval, sessile, entire leaves; native of Asia, and cultivated throughout the warmer and more temperate regions of Europe, on account of its fruit, which is extensively employed in its green state, as a pickle, and when ripe furnishes the well known walnuts of commerce.

Corylus. *Gen. char.*—(1) Cal. scale of the catkin three-cleft; cor. none; stamens eight. (2) Cal. two-cleft, ragged; cor. none; styles two; nut ovate, smooth, one-celled, covered with a leathery inflated calyx.

Cor. *Avellana*, Hazel-nut Tree; with ovate, obtuse stipulæ, roundish, heart-shaped, pointed leaves, and small branches hairy; common in woods and hedges.

Cor. *Colurna*, Constantinople Hazel; is much cultivated in some of the Greek islands on account of the excellence of its nuts, which are greatly esteemed in the Turkish metropolis, from which probably the trivial name is derived. The bark of this species produces a fungous substance, similar to the cork of the oak.

Calla. *Gen. char.*—A plain spathe; the spadix, or flower stem, covered with florets; cal. none; petals none; berries many-seeded.

Cal. *Æthiopica*, Ethiopian Calla; with arrow-headed, heart-shaped leaves; native of the Cape, of the sides of rivulets in St Helena, and of the ditches in India, and is now common in the green-house and parlour of this country.

Arum. *Gen. char.*—Spathe one-leaved, convoluted at the base; spadix or flower-spike cylindrical, naked above; flowers below producing pistils, and those in the middle stamens; berries one-celled.

Ar. *Maculatum*, Cuckow-pint or Wake-robin; with halberd-shaped, entire leaves; spadix or flower-spike club-shaped, blunt. Not uncommon in hedges and among brushwood.

Ar. *Triphyllum*, Zebra-flowered Arum; with trifoliate leaves, leaflets oval-pointed. Native of North America; is the largest and most beautiful of the genus, and has been introduced into the gardens of this country. *Bot. Mag.* xxiv. 950.

Monadelphia.

Pinus. *Gen. char.*—(1) Cal. scale of the catkin peltate; cor. none; anthers sessile, attached to the scales. (2) Cal. scale of the catkin two-flowered; cor. none; nut one-celled, winged.

Pin. *Sylvestris*, Scotch Fir; with double, rigid, linear, acute leaves; younger cones on foot-stalks bent back; summit of the anthers small. Not uncommon in the elevated districts of Scotland, and the only species indigenous to the island.

Pin. *Cedrus*, the Cedar Pine; Pin. *Larix*, the Larch-tree; Pin. *Picea*, the Pitch Pine, and some other species,—are natives of other parts of Europe, of the north of Asia, or of America.

Ricinus. *Gen. char.*—(1) Cal. five-parted, cor. none, stamens numerous. (2) Cal. three-parted, cor. none, styles three, caps. three-celled.

Ric. *Communis*, Common Oil-nut Tree; with deeply divided leaves. This plant, which has been long known by the trivial name of *Palma Christi*, is cultivated in the West Indies for the sake of its seeds. The growth is so rapid that it attains the full size of fifteen, and even twenty feet, in a single year. From the seeds, or nuts, the castor oil, so much employed in medicine, is obtained, either by expression, when it is said to be cold-drawn, and is esteemed of the best quality; or by boiling, the product of which brings an inferior price.

Ric. *Inermis*, Unarmed Oil-nut Tree; with peltate, somewhat palmated, serrated leaves, and unarmed fruit. A native of the Spanish West Indies, and much cultivated in Jamaica, because the nuts are larger and more productive, and the quality of the oil equal to the former. Excepting in the fruit being destitute of prickles, this plant resembles the other so closely that it is regarded rather as a variety than a distinct species.

Jatropha. *Gen. char.*—(1) Cal. none; cor. five-cleft; stamens ten. (2) Cal. none; cor. five-petaled; styles three; caps. three-celled.

Jat. *Manihot*, Bitter Cassada; with palmated leaves, lance-shaped, entire lobes. This plant, from the root of which cassada-bread, a very nutritious substance, is obtained, is much cultivated in the West Indies, and rises, by a slender woody stalk, to the height of five or six feet. The roots, which grow to a large size, are fit for use in eight months from the time of planting; being well washed and scraped, they are grated down into a kind of pulpy meal, which is put into strong linen bags, and subjected to powerful pressure, that the whole of the juice may be separated. The meal is then dried in the sun, beaten in a wooden mortar, and passed through a coarse sieve. In this state, and without any addition, it is spread on flat iron plates fixed in a stove. By the action of the heat, the particles of the meal coalesce, and form cakes, which, being thoroughly baked, are eaten as a wholesome and nourishing bread. The juice of the cassada-root is of a poisonous nature, and is extremely noxious to most animals; so that this deleterious substance must be separated before the root can be employed as food.

A variety of this species, called Sweet Cassada, the root of which is free from any deleterious quality, is also cultivated in the West Indies.

Jat. *Gossypifolia*, Cotton-leaved, or Wild Cassada; with five-parted leaves, and ovate, entire, ciliated lobes. Native of Jamaica, and common about the streets of Spanish-Town and Kingston.

Hura. *Gen. char.*—(1) Cal. two-leaved; cor. none; anthers twenty, sessile. (2) Cal. cylindrical; cor. none; one pistil; caps. ten-celled.

Hura *Crepitans*, Crackling Sand-box Tree; A native of Jamaica; rises to the height of thirty or forty feet, and with its large heart-shaped leaves, some of which are near a foot in length, and of a beautiful green, forms a thick shade. The capsule is of a woody texture, round and flat, and regularly divided into cells, each of which contains a single seed. The seeds being taken out, the shell is converted into a sand-box, from which the name is derived; and when the seeds ripen on the tree, the cells burst with an explosive noise, and discharge the seeds to a considerable distance. This is the origin of the specific name.

Hippomane. *Gen. char.*—(1) Cal. two-cleft; cor. none; anthers two-cleft. (2) Cal. three-cleft; cor. none; stigma three-fold; drupe or capsule one-seeded, or three-celled.

Hip. *Mancinella*, Manchineal Tree; with ovate serrated leaves. A native of Jamaica; grows to a large tree, the wood of which answers well for furniture, and produces a fruit having some resemblance to the crab-apple. The fruit seems to possess, in certain stages of its growth, an acrid or deleterious quality; and indeed it was supposed, from the idle tales of credulous travellers, that it is a deadly poison. Even the drops of rain which fell from the leaves were said to have acquired so much acrimony as to corrode the clothes and skin of those on whom they fell; but these stories are altogether without foundation. We have often taken the shelter of a manchineal tree, loaded with fruit, during the torrents of rain of that tropical climate, and never experienced the slightest injury.

Syngenesia.

Cucumis. (1) Cal. five-toothed; cor. five-cleft; filaments three. (2) Cal. five-toothed; cor. five-cleft; style three-cleft.

To this genus belong the Common Cucumber, Cuc. *Sativus;* the small Wild Cucumber of Jamaica, Cuc. *Anguria*, which is employed with other pot-herbs in soups; the Melon, Cuc. *Melo*, of which

Diœcia.

there are several varieties; and Coloquintida, or Bitter Apple, Cuc. *Colocynthis*, a native of Turkey, which is sometimes employed in medicine.

Class XXII. Diœcia.

In this class the flowers which produce stamens, and those which produce pistils and seeds, are on different plants. The characters of the orders are taken, as in the preceding, from the number and connection of the stamens.

Diandria.

Vallisneria. *Gen. char.*—(1) Sheath many-flowered, two-parted; cor. three-parted. (2) Sheath one-flowered; cal. three-parted; cor. three-parted; one pistil; caps. one-celled.

Val. *Spiralis*; a remarkable aquatic plant, which shoots up from the bottom of ditches in Italy, and in still places of the river Rhone. The flowers, bearing stamens, are produced from a distinct root, on short straight stalks; and, as they approach to maturity, are separated from the stalks, suddenly expand when they reach the surface, and float about in great profusion. The fertile flowers are attached to long spiral stalks, which, by uncoiling, permit them to rise to the surface, where the seeds are ripened in the open air. The spiral stem is finely accommodated to the variable depth of the waters in which this curious plant grows.

Salix. *Gen. char.*—(1) Cal. a scale of the catkin; cor. none; gland of the base nectariferous; stamens two, seldom five. (2) Cal. a scale of the catkin; cor. none; stigmas two; caps. superior, one-celled, two-valved; seeds downy.

Sal. *Helix*, Rose Willow; with lance-shaped, pointed, serrated, smooth leaves; style lengthened, thread-shaped, and stigmas linear. In willow and marshy grounds; rarely exceeds ten feet in height, and is much employed in all kinds of basket-work.

Sal. *Triandra*, Long-leaved, or Smooth Willow; with linear, oblong, serrated, smooth leaves, and germens on footstalks. Frequent in willow grounds and on the banks of rivers; rises to the height of thirty feet, and is esteemed one of the most valuable basket willows.

Sal. *Pentandra*, Sweet Willow, or Bay-leaved Willow; with five stamens; elliptical, lance-shaped, notched, smooth leaves, and germens smooth, nearly sessile. On banks of rivers in the north of England and south of Scotland.

Sal. *Vitellina*, Yellow Willow; with lance-shaped, acute, serrated leaves, smooth on the upper surface; serratures cartilaginous; stigmas notched. In willow grounds and marshes.

Sal. *Fragilis*, Crack Willow; with lance-shaped, serrated, very smooth leaves; footstalks toothed, glandular, and nectary in the flowers bearing stamens double. In willow grounds, and on the banks of rivers, and is remarkable for the brittleness of its branches. The bark of this species is sometimes employed as a substitute for Peruvian bark.

Sal. *Alba*, Common White Willow; with lance-shaped, pointed, serrated leaves, downy on both sides, the lowest serratures glandular. In woods and moist meadows, and becomes a tall tree.

Diœcia.

Of this genus forty-three species are described in the *Flora Britannica*. *Salix Babylonica*, Weeping Willow, is cultivated on account of the elegance and beauty of its delicate pendulous branches.

Triandria.

Empetrum. *Gen. char.*—(1) Cal. three-parted; cor. three-petaled; stamens capillary from three to nine. (2) Cal. three-parted; cor. three-petaled; stigmas nine; berry superior, nine-seeded.

Emp. *Nigrum*, Black Crow, or Crake Berry; with trailing stems. Frequent in elevated heaths in the northern parts of Britain.

Ruscus. *Gen. char.*—(1) Cal. six-leaved; cor. none. (2) Cal. six-leaved; cor. none; pistil one; berry superior, three-celled; seeds double.

Rus. *Aculeatus*, Knee-holly, or Butcher's Broom; with dagger-pointed sharp leaves, producing flowers on the upper surface. In woods and heaths in a gravelly soil; abundant at Stoke near Gosport.

Tetrandria.

Viscum. *Gen. char.*—(1) Cal. none; petals four, dilated at the base, united, and in the form of calyx; anthers sessile, attached to the petals. (2) Cal. slightly margined; petals four, dilated at the base; style none; berry inferior, one-seeded.

Vis. *Alumb*, Misseltoe; with lance-shaped, obtuse leaves; divided stem; spikes axillary. This is the celebrated misseltoe, a parasitical plant, which attaches itself to trees, and was held in great veneration by the ancient druids, who employed it in the celebration of their mysterious rites.

Myrica. *Gen. char.*—(1) Cal. scale of catkin concave; cor. none. (2) Scale of the catkin hollow; cor. none; styles two; berry one-seeded.

Myr. *Gale*, Sweet Gale, or Dutch Myrtle; with lance-shaped slightly-serrated leaves, and shrubby stem. Not uncommon in marshy places; grows to the height of two or three feet, and may be readily distinguished by its agreeable fragrance. In Wales and in Scotland it is sometimes employed to keep off vermin from clothes and apartments, to tan calf-skins, and to communicate a yellow colour to wool.

From the berries of Myr. *Cerifera*, Candle-berry Myrtle, a native of North America, candles for domestic use are made.

Trophis. *Gen. char.*—(1) Cal. none; cor. four-petaled. (2) Cal. and cor. none; style two-cleft; berry one-seeded.

Troph. *Americana*, Ramoon Tree. A native of Jamaica; rises to the height of twenty feet; and the leaves and tops of the branches afford a nutritious and desirable food for horses and cattle, and are thus employed in dry seasons when the grass crops are deficient.

Pentandria.

Cannabis. *Gen char.*—(1) Cal. five-parted; no corolla. (2) Cal. one-leaved; cor. none; styles two; seed, a nut.

Can. *Sativa*, Hemp. A native of India, but extensively cultivated in Europe on account of the fibres of the stem, which furnish the hemp of commerce, one of the most important substances in the arts.

Humulus. *Gen. char.*—(1) Cal. five-leaved; cor. none; anthers with a double pore at the summit. (2) Cal. scale of the catkin oblique, entire; cor. none; styles two; seed one, coated.

Hum. *Lupulus*, Hop; grows among brushwood and in hedges, was introduced from Flanders into England about 1520, and is now extensively cultivated on account of its seeds and membranous seed-coverings, which furnish the hops of commerce, the infusion of which, of a bitter aromatic nature, is employed for preserving and communicating an agreeable flavour to malt liquors.

Hexandria.

Myristica. *Gen. char.*—(1) Cal. one-leaved, three-cleft; cor. none. (2) Cal. one-leaved, three-cleft; cor. none; germen oval; fruit a drupe. Three species of this genus have been described; but by far the most important is the Nutmeg Tree, *Myristica Moschata*, which produces the precious and delicate spice, and which is a native of many of the islands in the East Indies; but its cultivation was chiefly confined by the Dutch to the island of Banda, for the purpose of retaining a monopoly of the trade; and, with the same view, all the plants within their power in the other islands were destroyed.

The nutmeg tree grows to the height of thirty feet. When the nutmegs are ripe, the natives ascend the trees and collect them with the hand, by pulling the branches near them with long hooks. The fruit, in this state, is composed of a green shell, or rind, of a fibrous substance of a beautiful red colour, which is the spice called mace, and of the nutmeg itself, which is inclosed within the two coverings. When the first rind is separated, which is done when they are gathered from the tree, the nutmegs are carried home, and the mace is carefully taken off with a small knife. Exposed to the sun for a day, and afterwards placed in an airy situation, the mace loses its bright red colour, is moistened with sea-water to prevent it from drying too much, and is then put into small bags and strongly pressed, when it is ready for the market.

The nuts, which are still covered with a woody shell, are exposed to the sun for some days, afterwards dried before a fire, and then beaten with small sticks to remove the shell, which flies off in pieces. The nutmegs thus prepared are distributed into three parcels, the first of which includes the largest and best formed, which are destined for the European market; the second contains those of an inferior kind, which are reserved for the consumpt of the country; and the third contains those which are unripe and of a small size, which are usually burnt.

Before they are ready for exportation, the nutmegs are subjected to another process; to prevent the depredations of insects, they are immersed two or three times in a mixture of lime and salt-water, afterwards laid in a heap, where they heat, and after having sweated sufficiently they are prepared for a sea voyage.

Octandria.

Populus. *Gen. char.*—(1) Cal. scale of the catkin ragged; cor. turbinated, entire. (2) Cal. scale of the catkin ragged; cor. turbinated, oblique, entire; stigmas four; caps. superior, two-celled, two-valved; seeds downy.

Pop. *Alba*, Great White Poplar; with heart-shaped, roundish, lobed, toothed leaves, hoary underneath; catkins ovate. In moist woods.

Pop. *Tremula*, Trembling Poplar, or Aspen; with roundish toothed leaves, smooth on both sides; footstalks compressed; branches rough. In moist woods, and becomes a tall tree.

Pop. *Nigra*, Black Poplar; with rhomboidal, pointed, serrated leaves, smooth on both sides; a lofty tree, which grows on banks of rivers, and in watery places.

Rhodiola. *Gen. char.*—(1) Cal. four-parted; petals four; nectaries four, notched. (2) Cal. four-parted; petals four; nectaries four, notched; pistils four; caps. four; many-seeded.

Rhod. *Rosea*, Rose-root. On the mountains of Wales and Yorkshire, and frequent on the rocky shores of the Western islands of Scotland; it is easily recognised by its succulent, smooth, azure, imbricated leaves, and yellowish flowers.

Enneandria.

Mercurialis. *Gen. char.*—(1) Cal. three-parted; cor. none; stamens from nine to twelve. (2) Cal. three-parted; cor. none; styles two; caps. two-celled; seeds single.

Merc. *Perennis*, Perennial Dog's Mercury; with very simple stem, rough leaves, and creeping root; perennial; flowers in April and May, and is common among brushwood.

To an inexperienced eye this plant has something of the appearance of spearmint, and has been used by mistake in the form of infusion, with fatal effects to those who swallowed it. It is said also to be equally deleterious to other animals, sheep, for example, as to man.

Merc. *Annua*, Annual Dog's Mercury; with branched stem, smooth leaves, flowers in racemes, and fibrous root; frequent in waste places near towns.

Decandria.

Carica. *Gen. char.*—(1) Cal. scarcely any; cor. five-cleft. (2) Cal. five-toothed; cor. five-petaled; stigmas eight; berry many-seeded.

Car. *Papaya*, Papaw Tree; with leaves peltate-lobed; lobes variously sinuated. Native of Jamaica, and rises with a soft herbaceous stem to the height of eighteen or twenty feet. The fruit of the papaw grows to the size of a small melon; in its green state is employed as a pickle or preserve; when ripe, is eaten like the melon with pepper, sugar, and salt; or boiled, is beaten up like turnips for the table; and the leaves are employed by the negroes for washing clothes.

Monadelphia.

Juniperus. *Gen. char.*—(1) Cal. scales of the catkin; cor. none; stamens three. (2) Cal. scales of the catkin few, become at last fleshy, and unite into a three-seeded berry.

Jun. *Communis,* Common Juniper; with leaves ternate, spreading, needle-shaped, longer than the berry. Common in heaths and elevated places, and well known by the sweetish aromatic berries which it produces.

Taxus. *Gen. char.*—(1) Cal. none; cor. none; stamens numerous; anthers peltate, eight-cleft. (2) Cal. pitcher-shaped, entire; style none; seed one, placed on the berried calyx.

Tax. *Baccata,* Yew Tree; with approximating leaves; grows in mountainous woods, and moist, loamy soils. The remains of an old wood of yew trees in Upper Lorne, in the Western Highlands of Scotland, were observed by Mr Lightfoot; and the trunk of a decayed yew tree in Fortingal church-yard is mentioned by Mr Pennant, in his tour in Scotland, as 56½ feet in circumference. Before the use of fire-arms, when the bow and arrow formed a principal warlike instrument, the yew, it is said, was planted in every church-yard to supply the inhabitants with bows. As an evergreen, and susceptible of pruning into any form, the yew was much employed in the old fashioned style of gardening in this country, for thick lofty hedges. The wood is reddish and veined, hard, and smooth, and much employed in cabinet-making and turnery.

The berries of the yew-tree are generally admitted to be free from any poisonous quality, but the leaves have been supposed to be deleterious to animals; but it seems doubtful whether this charge be not less owing to any noxious property than to its lurid aspect and peculiar situation, which have furnished an impressive image to the author of the "Grave."

> Well do I know thee by thy trusty yew,
> Cheerless, unsocial plant, that loves to dwell
> Midst skulls and coffins, epitaphs and worms;
> Where light-heeled ghosts, and visionary shades,
> Beneath the wan, cold moon, as fame reports,
> Embodied thick, perform their mystic rounds.
> No other merriment, dull tree, is thine.—Blair.

Class XXIII. Polygamia.

In this class the stamens and pistils are separate in some flowers, and they are united in others, either on the same or on two or three distinct plants. This diversity is the foundation of the three orders into which the class is divided. As in the two former classes, the flowers with stamens are marked by the figure (1), and the flowers with pistils by the figure (2). The flowers producing both stamens and pistils are marked (3).

Order I. Monœcia.

Musa. *Gen. char.*—(3) Cal. none; cor. two-petaled; stamens six, one of which is fertile; fruit inferior. (3) Cal none; cor. two-petaled; stamens six, five of which are perfect; pistil one; no berry.

Musa *Paradisaica,* Plantain-tree; with nodding spadix or flower-spike, and flowers producing stamens permanent. This remarkable plant is cultivated in the West Indies on account of its fruit, and rises to the height of 15 or 20 feet, on a round, soft stem, composed of the elongated footstalks of the leaves; which latter are sometimes eight feet in length and two in breadth. The fruit or plantains are about a foot in length, and two or three inches in diameter, when fully grown, and of a pale yellow colour, and luscious sweet taste. A bunch of fruit, from a single plant, sometimes exceeds 40 pounds in weight; but the plantain is generally used as an excellent substitute for bread, before it is ripe and has acquired the sweet taste; and for this purpose, the outer skin being removed, it is either roasted or boiled. Plate 34. Fig. 5.

Musa *Sapientum,* Banana Tree; with the spadix or flower-spike nodding, and flowers producing stamens deciduous. The banana tree nearly resembles the plantain, but the stem is marked with dark purple spots, the fruit is shorter, rounder, and in more compact bunches, and when it is ripe the pulp is of a more agreeable flavour and more delicious taste.

The plantain and banana are supposed to have been brought originally from Guinea to the Canary islands, and from them introduced to the West Indies, where they have been long extensively cultivated. The green leaves are an excellent food for horses or cattle; cordage is made of the fibres of the plant by the natives of the Philippine islands; and encouragement has been given to a similar manufacture by public premiums in Jamaica.

Mimosa. *Gen. char.*—(1) Cal. five-toothed, cor. five-cleft, stamens five, ten, or more. (3) Cal. five-toothed, cor. five-cleft, stamens five or more, pistil one, fruit a pod.

Mim. *Verticillata,* Whorled-leaved Mimosa; unarmed, with linear sharp leaves in whorls. In this species, as in some others from Botany Bay, of which it is a native, the leaves on the seedling plants are pinnated, but afterwards grow in whorls; it is a greenhouse plant, and ripens its seeds in this country.

Many species of this genus are natives of New Holland. Mimosa *Nilotica,* is a native of Egypt and the East, and produces the gum-arabic of commerce; see Plate 34. Fig. 3.: And Mimosa *Pudica,* is a well known plant in the stove, and remarkable for the irritability of its leaves and stems, which shrink and contract with the slightest touch.

Atriplex. *Gen. char.*—(3) Cal. five-parted, inferior; cor. none; stamens five; style two-parted, seed one. (2) Cal. two-leaved; cor. none; style two-parted; seed one, compressed.

At. *Patula,* Spreading Halberd-leaved Orache; with spreading shrubby stem, leaves somewhat square and halberd-shaped. Common in waste and cultivated grounds, and exhibiting some varieties when it grows on the sea-shore.

At. *Angustifolia,* Narrow-leaved Orache; with entire lance-shaped leaves, the lowest somewhat halberd-shaped; common in waste and cultivated places.

In the second order of this class, Diœcia, the different flowers are on two different plants; but excepting *Hippophae,* which is generally arranged under Monœcia Tetrandria, no distinct example has occurred to the extensive experience and acute observation of Dr Smith.

Order III. Triœcia.

Ficus. *Gen. char.*—Common receptacle, turban-shaped, converging, closed, fleshy. (3) Cal. five-parted, cor. none, pistil one, seed one. (1) Cal. three-parted, cor. none, stamens three. The flowers producing stamens and those producing pistils are included within the same common receptacle, but with the partial fructification distinct.

Fic. *Carica,* Fig Tree; with palmated, nearly three-lobed leaves, and pear-shaped, smooth fruit. The figs of commerce are the preserved fruit of this tree, which is extensively cultivated in Turkey, and in the warmer regions of Europe.

Fic. *Indica,* or Banyan Tree, is one of the most remarkable vegetable productions; shoots are thrown out from the horizontal branches, and as they extend towards the earth increase in size, and at last strike into the ground and become stems. New branches push out, which, as they extend, again form roots and new stems, till at last a single tree becomes the parent of an extensive grove, appropriately characterised by the poet as a "pillared shade high overarched." Some banyan trees cover an immense extent of surface. A tree of this description in an island of the river Nerbudda, in India, occupies a space which exceeds 2000 feet in circumference; the chief trunks amount to 350, and the number of smaller stems is more than 3000, although it is considerably reduced by the encroachment of floods on the banks of the island.

Cubbeer Burr, the name of this famous tree, derived from a venerated saint, is celebrated throughout Hindostan for its beauty and magnitude; thousands of votaries, from all parts of the Mogul empire, repair to the sacred spot, at stated seasons, to attend solemn festivals; seven thousand persons, it is said, may repose under its ample shade; and numerous colonies of wood-pigeons, peacocks, and singing birds, with large families of monkeys, find abundant accommodation in its thick, wide-spreading branches, which, in the proper season, offer a copious supply of small scarlet-coloured figs, as food to its crowded inhabitants. The banyan tree may be regarded as a natural temple in eastern regions; it is held sacred by the natives, and idols are set up under its shade, before which they perform their devotions. It is also called the *tree of councils,* from the people assembling under its shade for deliberating on civil affairs. Plate 34. Fig. 4.

Class XXIV. Cryptogamia.

In this class the parts of fructification are so minute that they cannot be arranged according to the principles observed in the preceding classes; but the plants which it includes are considerably different in their structure and habits from the other vegetable tribes; it is divided into five orders.

Order I. Filices, or *Ferns.*

This order is subdivided into three sections, which are characterised by the fructifications being spiked, arranged on the under surface of the leaf or frond, or being near the root.

Equisetum. *Gen. char.*—Catkin with peltated scales including the parts of fructification; small involucrums, two-valved; seeds numerous, naked, infolded by four filaments producing pollen.

Equis. *Palustre,* Marsh Horsetail; with angular branched stems; fructifications on the summit; branches simple, erect, slightly rough. In wet and marshy places.

Equis. *Arvense,* Corn Horsetail; with barren stems, branched all round; branches slightly rough, stems producing seed, simple. Frequent in moist meadows, and among corn in a wet soil.

Equis. *Hyemale,* Rough Horsetail, or Shavegrass; with a naked, very rough stem, slightly branched at the base, and terminal catkin. In marshes and moist woods; and to the habitats noticed in the Flora Britannica may be added, a place where water stood in the winter on the Newton-green near Ayr, and the banks of the Doon, three miles south from the same place. The dried stems are much employed by cabinet-makers for polishing their work.

Ophioglossum. *Gen. char.*—Spike two-rowed, capsules two-valved, sunk, and opening transversely.

Oph. *Vulgatum,* Common Adder's-tongue; with ovate veinless frond; in moist meadows and pastures, but not very common.

Osmunda. *Gen. char.*—Spike branched, capsules two-valved, naked, globular.

Os. *Lunaria,* Common Moonwort; with pinnated frond, and spike rising from the base; the leaflets crescent-shaped, crenated. In dry pastures and meadows.

Os. *Regalis,* Royal Moonwort, or Flowering Fern; with frond twice pinnated, and spike produced at the summit; leaflets heart-shaped, lanceolate, smooth. This splendid plant, when in full vigour, rises to the height of three or four feet, and is not uncommon in marshy places and the crevices of rocks in the Western Highlands of Scotland.

Lycopodium. *Gen. char.*—Capsules axillary, single, two-valved, naked, slightly kidney-shaped, compressed.

Lyc. *Clavatum,* Common Clubmoss; with scattered filamentous leaves; flower-bearing stems, bristly. Not uncommon in elevated heaths, and readily distinguished by its long, trailing, branched stems, and erect flower-stalks, which are sometimes divided into two or three spikes.

Lyc. *Selago*, Fir Clubmoss; with entire lance-shaped scattered leaves, and erect divided stem. In moist places on mountainous heaths.

Polypodium. *Gen. char.*—Fructifications in roundish points; scattered; not marginal; no involucrum.

Pol. *Vulgare*, Common Polypody; with pinnatifid frond, lobes oblong, somewhat serrated, obtuse; root scaly. Common on walls and on the trunks of trees.

Pol. *Phegopteris*, Pale Mountain Polypody; with pinnated frond; leaflets lance-shaped, pointed, pinnatifid, united at the base, the lowest reflected. In fissures of rocks and moist places, in elevated situations, but not very common. Plate 35. Fig. 7.

Aspidium. *Gen. char.*—Fructifications in roundish points, scattered, not marginal, involucrum umbilicated, opening almost on all sides.

Asp. *Filix Mas*. Male Fern; with doubly pinnated frond; leaflets, obtuse, serrated, with chaffy footstalk; involucrum bent inwards. Common in woods and shady places.

Asp. *Aculeatum*, Common Prickly Shield Fern; with doubly pinnated frond, leaflets ovate, crescent-shaped, ciliated, spinous, hairy underneath. In moist rocky places and woods. Plate 35. Fig. 8.

Blechnum. *Gen. char.*—Fructifications in continuous longitudinal lines near the rib; involucrum superficial, continuous, opening towards the rib.

Blech. *Boreale*, Rough Spleenwort; with smooth pinnated frond; leaflets linear, bluntish, entire, nearly equal at the base. Common in woods and heaths. Plate 35. Fig. 5. Osmunda *spicant* of Lightfoot and others.

Scolopendrium. *Gen. char.*—Fructifications in double scattered lines, involucrum superficial, opening longitudinally.

Scol. *Vulgare*, Common Hart's-tongue; with simple lance-shaped frond, smooth underneath. Common in moist, rocky, and shady places. Plate 35. Fig. 6. *Asplenium Scolopendrium*, Spec. Plant. of Lightfoot and other botanists.

Asplenium. *Gen. char.*—Fructifications in scattered lines; involucrum opening towards the rib.

Asplen. *Marinum*, Sea Spleenwort; with pinnated frond, leaflets ovate, oblique, serrated, obtuse, unequal at the base, and wedge-shaped. Rocks near the sea in Britain.

Asplen. *Septentrionale*, Forked Spleenwort; with pinnated, three-cleft frond, leaflets alternate, linear, ragged at the summit. In the fissures of rocks; Arthurs' Seat, Edinburgh. *Acrostichum Septentrionale* of Lightfoot, Withering, and others.

Asplen. *Palmatum*, Palmated Spleenwort; with five-lobed, heart-shaped frond; three intermediate lobes pointed. Native of Spain, Portugal, and the Canary Islands. Plate 35. Fig. 1.

Lonchitis. *Gen. char.*—Fructifications in lines under the sinuses of the frond.

Lon. *Hirsuta*, Hairy Spleenwort; with blunt entire pinnatifid fronds; native of the mountains of Jamaica, and grows to the height of four or five feet.

Lon. *Pedata*, Footed Spleenwort; with fronds pedate, leaflets pinnatifid and slightly serrated. Native of the mountains of New Liguanea, in Jamaica; grows two or three feet in height on a single stalk; divides into three parts, of which the middle is a single frond, and the lateral divisions are composed of three fronds each. Plate 35. Fig. 2. a single frond, and Fig. 3. the entire plant.

Adiantum. *Gen. char.*—Fructifications in roundish, distinct, marginal points.

Ad. *Capillus Veneris*, True Maiden-hair; with the frond alternately decompounded; leaflets wedge-shaped, lobed, on footstalks. On rocks and moist walls near the sea.

Lindsæa; fructifications linear, continued, submarginal; capsules opening interiorly.

Lind. *Reniformis*, Kidney-shaped Lindsæa; with simple, kidney-formed, very obtuse frond. Native of Guiana. *Lin. Trans.* Vol. III. See Plate 35. Fig. 4.

Pteris. *Gen. char.*—Fructifications in a continued marginal line; involucrum from the inflected margin of the frond, continuous, opening interiorly.

Pter. *Aquilina*, Common Brakes; with supra-decompound frond, leaflets lance-shaped, somewhat acute; the lowest pinnatifid, the upper smaller. In heaths and neglected pastures, very common.

Order II. Musci, *Mosses*.

The plants arranged under this order are furnished with distinct leaves, and often with a distinct stem. The membranous corolla, which is of a conical form, is called a *calyptra*, or veil, and the summit is the stigma. This veil covers the capsule, which, before the seed ripens, is raised on a footstalk. The capsule, which opens by a vertical lid, consists of one cell and one valve, and the seeds are extremely minute and numerous. The stamens and pistils of the mosses are generally in separate plants, but in a few species they are united in the same flower.

According to the method adopted by Linnæus, the genera of mosses are determined chiefly by the lateral or terminal situation of the capsule; but the structure of the fringe or *peristomium*, which borders the orifice of the capsule, as proposed by Hedwig, affords more obvious and more precise marks of discrimination. The fringe is either simple or double, and is composed either of separate teeth, as is mostly the case, with the external fringe, or of a plaited and jagged membrane, which is the form of the inner fringe when it exists. The number of teeth, which is remarkably constant in each genus and species, is either four, eight, sixteen, thirty-two, or sixty-four.

The elegance and beauty which are exhibited in the form and structure of this singular tribe of plants, cannot fail to excite admiration, and amply reward curiosity for the care and industry requisite in studying them;—they are spread over the surface of the earth, are found in tropical climes, as well as in polar regions, and offer themselves for examination at all seasons; for even the severity of winter, which overwhelms the gayer beauties of the empire of Flora with desolation, and leaves behind a dreary waste, is not unfavourable to their growth and vigour.

The mosses are divided into three sections; as they are destitute of fringe, or as they are furnished with a single or double fringe. Of these sections the following are examples.

Sect. I. *With no Fringe.*

Sphagnum. *Gen. char.*—Capsule with a naked mouth; calyptra divided horizontally, surrounding the capsule at the base; anthers surrounded with a ring.

Sphag. *Latifolium*, Broad-leaved Bog Moss; with swelled deflected branches, and ovate, obtuse, inflated leaves; very common in marshy bogs.

Sphag. *Capillifolium*, Slender Bog Moss; with thread-shaped, deflected branches, and ovate-lance-shaped, plain, pointed, closely imbricated leaves; in moist places on elevated heaths.

The two species now described are synonymous with Sphagnum *Palustre*, of the Species Plantarum, Withering, and others.

Phascum. *Gen. char.*—Capsule ovate, closed, deciduous, with the operculum not opening.

Phas. *Subulatum*, Awl-leaved Earth Moss; with capsule nearly sessile, and leaves awl-shaped, spreading, dilated at the base, very slender at the summit; on heaths and sandy banks.

Phas. *Muticum*, Common Dwarf Earth Moss; with ovate, awnless, concave, closing leaves, and sessile globular capsule; frequent on banks and in hedges.

Phas. *Cuspidatum*, Sharp-leaved Dwarf Earth Moss; with ovate, bearded, pointed leaves; upper leaves closing, and capsule broadly elliptical, nearly sessile. In heaths, banks, and walks, especially in a sandy soil, abundant.

Gymnostomum. *Gen. char.*—Capsule with a naked mouth, and deciduous lip; entire calyptra separating from the base.

Gymnost. *Truncatulum*, Little Blunt-footed Beardless Moss; with ovate, pointed, plain, entire leaves, and turban-shaped truncated capsule. In flowers, banks, and by the sides of ditches.

Gymnost. *Ovatum*, Hairy-leaved Beardless Moss; with ovate, obtuse, very entire, concave, awned leaves, and ovate capsule; on banks and mud walls.

Gymnost. *Pyriforme*, Pointed Pear-shaped Beardless Moss; with very simple and very short stem; leaves ovate, acute, slightly toothed; capsule obovate, and lid bluntly dagger-shaped. On banks and wet heaths.

Sect. II. *With a Simple Fringe.*

Splachnum. *Gen. char.*—Capsule cylindrical, set upon a fleshy process; fringe simple, with sixteen teeth approaching by pairs.

Splach. *Mnioides*, Green Tapering Gland Moss; with the process obconical, green, and leaves elliptical, lance-shaped, entire, awned; in moist places of elevated districts.

Splach. *Ampullaceum*, Purple Gland Moss; with greenish, purple, obconical, blunt process, three times thicker than the capsule; leaves lance-shaped, acute, serrated. In marshy bogs and moist heaths.

Tetraphis. *Gen. char.*—Capsule oblong; fringe with four pyramidal, erect, loose teeth.

Tet. *Pellucida*, Transparent Four-toothed Moss; *Mnium Pellucidum*, Spec. Plant. In moist, shady places, and at the roots of trees.

Encalypta. *Gen. char.*—Capsule cylindrical; fringe with sixteen linear, upright teeth; calyptra bell-shaped, inflated, loose.

Enc. *Vulgaris*, Common Extinguisher Moss; with calyptra, having a very entire, smooth margin; stem nearly simple, and leaves lanceolate. In the fissures of rocks, on walls, and shady banks.

Enc. *Ciliata*, Greater Extinguisher Moss; with calyptra toothed on the margin; stem branched, and leaves lanceolate. On elevated rocks.

The two last species are varieties of *Bryum Extinctorium*. Spec. Plant.

Trichostomum. *Gen. char.*—Capsule oblong; fringe with thirty-two thread-shaped, somewhat upright teeth, joined in pairs, or connected at the base.

Trich. *Trifarium*, Three-ranked Fringe Moss; with leaves awl-shaped, keeled, entire, in three rows; capsule ovate, and stem branched. In barren places on mountains.

Trich. *Capillaceum*, Capillary Fringe Moss; with slender sheathing leaves in two rows, conical lid, and stems forming a close turf. In elevated marshes, as on the Pentland hills near Edinburgh.

Tortula. *Gen. char.*—Caps. oblong, with numerous thread-shaped teeth, spirally convoluted, and with many folds.

Tort. *Rigida*, Rigid Screw Moss; with very short stem; spreading, stiff, blunt leaves, rolled inwards, and without nerves; caps. cylindrical and lid conical. On rocks, banks, and walls. *Bryum Rigidum* of Withering, Hudson, and others.

Tort. *Ruralis*, Great Hairy Screw Moss; with branched stem; leaves blunt, recurved, hairy at the summit; upper leaves star-shaped; capsule ovate, cylindrical. Common on walls, cottages, and trunks of trees. *Bryum Rurale* of Spec. Plant. Withering, and others.

Tort. *Subulata*, Awl-shaped Screw Moss; with short, somewhat simple stem; leaves ovate, lance-shaped, pointed; caps. cylindrical, and lid awl-shaped, upright. Common in moist, shady places, but rare in the northern districts of Britain. *Bryum Subulatum* of Spec. Plant. Hudson, Withering, Lightfoot, &c.

Tort. *Muralis*, Wall Screw Moss; with very short, nearly simple stem; leaves ovate, sharp, hairy; caps. elliptic, cylindrical, and lid conical. One of the most common mosses; on walls and houses. *Bryum Murale*, Spec. Plant.

Sect. III. *With Double Fringe.*

Orthotrichum. *Gen. char.*—Caps. oblong, terminal; external fringe, with sixteen teeth; internal, with eight or sixteen thread-shaped, and sometimes none; calyptra often rough, with straight hairs, angular.

Orthot. *Striatum,* Common Bristle Moss; with branched stem; leaves lance-shaped, keeled, bent back, spreading; calyptra entire, and internal fringe with sixteen teeth. On the trunks of trees. *Bryum Striatum* of Spec. Plant. and Withering, and *Polytrichum Striatum* of Hudson and Hull.

Orthot. *Crispum,* Curled Bristle Moss; with branched stem; with linear leaves bent back and waved by drying, and footstalks lengthened and thickened at the summits. On trees. *Bryum Striatum,* Spec. Plant; *Bryum Crispum,* Withering.

Neckera. *Gen. char.*—Caps. oblong, proceeding from a lateral *perichætium* or sheath; external fringe, with sixteen sharp teeth; internal, with sixteen thread-shaped intermediate teeth; calyptra smooth.

Neck. *Pumila,* Small Feathery Neckera; with pinnated branches; leaves in two rows, ovate, slightly waved, and footstalk scarcely exceeding the sheath. On the trunks of trees, but rare. *Hypnum Pennatum* of Withering, and *Fontinalis Pennata* of Hudson.

Neck. *Crispa,* Crisped Neckera; with pinnated branches, leaves oblong, transversely wrinkled, and in two rows, and footstalk double the length of the sheath. On chalk-hills and elevated woods in a dry soil. *Hypnum Crispum,* Spec. plant. Hudson, Withering, Lightfoot.

Neck. *Heteromalla,* Lateral Neckera; with diffuse branched stem, leaves ovate, sharp, concave, imbricated on all sides, and capsule sessile, on one side. On the trunks of trees.

Mnium. *Gen. char.*—Caps. cylindrical, furrowed; external fringe, with sixteen teeth dilated at the base; internal, membranaceous, divided into segments; calyptra smooth, footstalk terminal.

Mnium *Androgynum,* Narrow-leaved Spring Moss; monœcious, caps. erect, lid conical; leaves imbricated, spreading, and toothed at the summit. In moist shady places.

Mnium *Palustre,* Greater-forked Spring Moss; diœcious caps. oblique, lid conical, leaves sharp. In marshy and flooded places.

Funaria. *Gen. char.*—Caps. obovate, external fringe, with sixteen teeth, oblique, uniting at the summit internal, with sixteen plain teeth; flowers terminal, calyptra square.

Fun. *Hygrometrica,* Twisting Cord Moss; with concave leaves and ventricose capsule. Common in moist, sandy heaths, gardens, and neglected walks. *Mnium Hygrometricum,* Spec. Plant. Withering, Lightfoot. The flower-stems twist round when moistened, or even breathed upon.

Bartramia. *Gen. char.*---Caps. round, furrowed; external fringe with sixteen teeth, dilated at the base; internal, membranaceous, folded, divided into various segments; calyptra smooth; lid depressed.

Bart. *Pomiforme,* Apple Bartramia; with footstalks erect, exceeding the stem; leaves awl-shaped, one-nerved. In shady places and crevices of rocks. *Bryum Pomiforme.* Spec. Plant.

Bart. *Fontana,* Fountain Bartramia; with erect footstalks exceeding the stem, entire ovate leaves, erect, thread-shaped, fasciculated branches. Abundant on the banks of rivers and in marshy places. *Mnium Fontanum,* Spec. Plant. Withering and Lightfoot.

Polytrichum. *Gen. char.*---External fringe, with thirty-two or sixty-four short inflected teeth; internal fringe, a plain undivided membrane; calyptra often double, the external one hairy.

Polyt. *Commune,* Hair-moss; with simple stem; leaves linear, lance-shaped, slightly serrated; caps. erect, square; external fringe, with sixty-four teeth; calyptra double. Common in moist woods and boggy places.

Polyt. *Undulatum,* Waved Hair Moss; with lance-shaped serrated leaves that curl in drying; cylindrical nodding capsule, and calyptra rough on the summit; teeth of the fringe thirty-two. Frequent in shady places and hedges.

Order III. Hepaticæ, *Liverworts.*

The plants included under this order are separated from the Algæ or Flags, under which they were arranged by Linnæus. In the Liverworts the herbage is commonly frondose; the fructification originates from what is at the same time both leaf and stem; and the capsules have no lid or operculum.

Jungermannia. *Gen. char.*—(1) On a footstalk and naked, anther four-valved. (2) Sessile naked, with roundish seeds.

Jung. *Trichomanes,* Powder-headed Jungermannia; with fronds simply pinnated; leaves ovate, plain, very entire; stem with the pistil at the summit. Near springs and rivulets in moist woods.

Jung. *Asplenoides,* Spleenwort Jungermannia; with fronds simply pinnated, leaflets ovate, slightly ciliated. In moist woods, at the roots of trees, and is said to be the largest of the British species.

Jung. *Complanata,* Flat Pale Green Jungermannia; with creeping shoots; leaflets eared below, and doubly imbricated; branches equal. Common on trunks of trees.

Jung. *Tamarisci,* Red Tamarisk Jungermannia; with leaves imbricated in a double series, upper leaves roundish, convex, obtuse, one-fourth larger. On trunks of trees, rocks, and in dry stony places; on the rocks of Edinburgh Castle.

Marchantia. *Gen. char.*—(1) Cal. shield-formed, covered underneath with one-leaved corollas; anthers much divided. (2) Cal. sessile, bell-shaped; many-seeded.

March. *Polymorpha,* Great Star-headed Marchantia; with the common calyx ten-cleft; by the sides of wells, and on moist rocks on the banks of rivulets.

A variety of this plant, which some have considered a different species, is smaller in all its parts, excepting the umbellated heads; it grows on walls, rocks, and neglected shady garden-walks.

March. *Hemisphærica,* Hemispheric Marchantia; with the common calyx five-cleft, hemispherical, and destitute of sheath. On wet banks, by the sides of rivers, not uncommon; in the King's park at Edinburgh. The leaves are slightly notched on the margin;

and the margin and under-surface are of a dark red or claret colour, covered with white downy radicles.

Order IV. Algæ, *Flags.*

In this order the herbage is frondose, sometimes of a leathery gelatinous consistence, and sometimes only a crust; and the seeds are produced either in a peculiar receptacle or in the frond itself.

Lichen. *Gen. char.*—(1) Receptacle roundish, somewhat plain, shining. (2) Dust scattered on the leaves.

Lich. *Scriptus*, Lettered Lichen; warty, whitish, with small black branched lines resembling letters. On the smooth bark of trees.

Lich. *Geographicus*, Map Lichen; warty, yellowish, with black lines resembling a map; frequent on rocks, as in the King's Park at Edinburgh.

Lich. *Islandicus*, Eatable Iceland Lichen; leafy, laciniated, with elevated fringed margins. On mountainous places in the Highlands and Lowlands of Scotland; on the Pentland hills near Edinburgh. This lichen contains a considerable proportion of mucilage, and has on that account been recommended as a cure, or as a mild nourishing aliment, in affections of the lungs. The inhabitants of Iceland grind it to powder, and use it as common food, by boiling it either in milk or water, or making it into bread.

Lich. *Rangiferinus*, Rein-Deer Lichen; shrubby, and very much branched. Common in woods and heaths. This plant is the chief support of the rein-deer, an animal of the utmost importance to a large proportion of the inhabitants of the polar regions.

Fucus. *Gen. char.*—(1) Vesicles interwoven with hairs. (2) Vesicles strewed with imbedded grains, slightly prominent at the summit; seeds solitary.

Fucus *Serratus*, Sea-wrack; with frond, plain, divided, ribbed, serrated, toothed, and tubercular terminal fructifications. On sea rocks at low water mark. The leaf is flat, radical, and about two feet long.

Fucus *Vesiculosus*, Common Sea-wrack, or Seaware, in Scotland; grows abundantly on rocks at low water mark, and is collected on the shores of Scotland for making kelp. Several other species of fucus are employed for the same purpose.

Fucus *Palmatus*, Palmated, or Sweet Fucus; dulse, or dilse, in Scotland; with a plain, hand-shaped frond. Common on sea-rocks, and frequently eaten by the inhabitants.

Fucus *Ruscifolius*; found on the southern shores of England; is represented on Plate 35. Fig. 9. Fucus *Menziesii*; a native of the western coast of North America, Fig. 10. Fucus *Sanguineus*, Dock-leaved Fucus; not uncommon on the shores of Britain; is a very elegant species, of a bright red or purple colour, Fig. 11. Fucus *Ilicifolius*, a native of the straits of Sunda, Fig. 12. Fucus *Fraxinifolius*, a native of the East Indies, Fig. 13. See *Historia Fucorum* by Turner.

Order V. Fungi, *or Mushrooms.*

The vegetable nature of this order of plants was long doubted by some naturalists, who were disposed to ascribe to them an animal origin; but the labours of Dryander, Schæffer, and Hedwig, have shewn that they possess a vegetable character, by detecting their seeds, and explaining the parts of fructification. In the *Synopsis Methodica Fungorum* of Persoon, the order of mushrooms is divided into such as produce their seeds internally, or in vessels, and such as have them exposed or imbedded in an appropriate membrane. To the first division belong *Sphæria* and *Lycoperdon*, or Puff-ball; and to the second *Helvella*, in which the seed membrane is smooth and even; *Boletus*, in which it is porous; and *Agaricus*, in which it is composed of parallel plates, denominated *Lamellæ*, or Gills.

Agaricus. *Gen. char.*---Fungus horizontal, lamellated underneath.

Ag. *Chantarellus*, Yellow Agaric, or Chantarelle, Paddock-stool in Scotland; with a stipe or footstalk, and branched lamellæ or gills. Frequent in woods. This species is of a yellow colour; the pileus, when young, is orbicular; when full grown the rim becomes waved and variously lobed; and the gills are branched, curled, and run down part of the stem.

Ag. *Integer*, Equal-gilled Agaric; furnished with a stem; all the gills of the same size. Not uncommon in woods.

Ag. *Piperatus*, Pepper Agaric; with a footstalk pileus plain, lactescent, margin deflected, gills pale, flesh-coloured. Frequent in woods. This mushroom is of a very acrid nature, yet, after being pickled with salt, is eaten by the Russians.

Ag. *Campestris*, Common Mushroom, or Champignon; with a footstalk; white, convex, scaly pileus, and reddish gills. Common in dry pastures after rains. This is the only mushroom which may be eaten with safety; and the juice, preserved with salt and spice, forms the sauce well known by the name of ketchup. The stalk of this mushroom is short, white, solid, and about the thickness of the finger; the pileus, when young, is white, hemispherical, fleshy, and covered with ragged scales; the rim is inflected, and the gills are rose or pink-coloured, and nearly of equal length.

Lycoperdon. *Gen. char.*---Fungus roundish, filled with mealy seeds.

Lyc. *Tuber*, Truffles, or Subterraneous Puff-balls; globular, solid, with sharp tubercles, and without root. Found in woods. This fungus is produced in clusters, three or four inches under ground. The truffles of this country rarely exceed three or four ounces in weight; but in Italy they acquire the enormous size of eight or ten pounds. They are eaten at table either fresh and roasted like potatoes, or dried and sliced as a seasoning to ragouts. Dogs are taught to discover them by the scent.

Lyc. *Bovista*, Common Puff-ball; roundish, opening irregularly. Common in meadows and pastures in the autumn. This species varies much in size, figure, and colour; it has been sometimes found in England as large as a man's head, and specimens have been gathered in Italy of the extraordinary weight of 25 lbs. and two yards in circumference.

APPENDIX.

Palms.

The natural order of palms exhibits such striking peculiarities in the structure and habits of the plants which it comprehends, as to be properly enough reserved for an appendix to the system, as was originally done by Linnæus, in consequence of the limited knowledge which he possessed of these remarkable vegetable productions. From the observations of succeeding botanists, it appears that palms have for the most part six stamens, more rarely three or nine, with three or six petals, and one or three styles. The stamens and pistils are sometimes in the same flower; sometimes in separate flowers on the same plant; and sometimes on different plants,—thus forming monœcious or diœcious plants. The fruit of the palms is generally a drupe. Having some affinity in structure to the liliaceous tribe, which were called by Linnæus the nobles, the palms, from their lofty stature and elegant form, have received the dignified appellation of the princes of the vegetable kingdom.

The genera of palms, which do not exceed ten or twelve, have been divided into three sections, the characters of which are taken from the form of the leaves. In the first they are fan-shaped; in the second pinnated, or wing-shaped; and in the third doubly pinnated.

Chamærops. *Gen. char.*—Diœcious; pericarp three globular one-celled drupes.

Cham. *Humilis*, Smaller Palmeto, or Fan-palm; with large fan-shaped leaves and smooth stems. A common plant in Jamaica, the leaves of which are much employed for thatching cottages; and the berries, which are sweet, are greedily devoured by birds. This species of palm is also a native of Europe; it grows as far north as the vicinity of Nice. Plate 36. Fig. 6.

Thrinax. *Gen. char.*—Perianth minute, six-toothed; stamens six; pericarp a naked berry, one-celled.

Thrin. *Parviflora*, Small-flowered Palmeto Royal, or Thatch-tree; with palmate plaited leaves. Native of Jamaica, and grows abundantly on rocky hills and low moist plains near the sea. It shoots up with a simple stem from ten to twenty feet in height. The leaves are used for thatch, and the trunk is employed for buildings in the sea, for which purpose it is well calculated from its durable quality.

Borassus. *Gen. char.*—Diœcious; (1) cal. a compound sheath; cor. with three oval and concave petals. (2) Cal. a sheath; cor. with three roundish petals; drupe or berry roundish, obtuse, with three seeds.

Boras. *Flabelliformis*, Fan-leaved Palm; with hand-shaped leaves, folded, wide at top, and drawn to a point below; footstalk serrated. This palm is a native of India, rises to the height of thirty feet, and is terminated with a bunch of fan-shaped leaves. The wood, which is hard and durable, is employed in building, and in the construction of domestic implements; the liquid which flows from the wounded tree affords, by evaporation, saccharine matter, and a spirit when it is fermented and distilled; screens and parasols are made of the entire leaves; and, divided into slips, they are converted into mats of various kinds; or, cut into small pieces, are used as a substitute for writing paper.

Corypha, or Mountain Palm, is also diœcious, with a drupe containing one seed; and it includes two species, which are natives of the East Indies and Carolina.

Phœnix. *Gen. char.*—(1) Cal. a three-parted one-valved sheath; cor. with three concave oval petals. (2) Cal. the same; cor. with three petals; fruit oval, one-seeded.

Phœn. *Dactylifera*, Date Tree; with pinnated leaves, leaflets sword-shaped, folded. To the inhabitants of many extensive regions of Asia and Africa, the date tree is the most important vegetable production; it grows with a straight cylindrical stem to the height of thirty or forty feet, thickly set on the upper part with scales, which are the vestiges of old leaves, and is terminated by a bunch of leaves nine or ten feet in length. The fruit is composed of a fine soft pulp, of a sweet and slightly vinous taste, and of a very wholesome and nutritious quality.

The date-tree is a native of the sandy districts of India, Arabia, and the northern regions of Africa; it grows also in the southern parts of Spain, in some of the islands of the Mediterranean, and in some places of France near the sea, although the fruit is rarely ripened; but in Arabia, and in those parts of Africa to the eastward of mount Atlas, countries which produce little corn, this valuable tree fortunately thrives most vigorously, and yields the best fruit. On the borders of the great desert which approaches to mount Atlas, the date-tree, as it supplies the deficiency of corn, and furnishes nearly the whole of the subsistence of the inhabitants, is cultivated with great care. The date-trees are planted at the distance of twelve feet from each other, in the vicinity of streams and rivulets, for the conveniency of supplying them with water, which is necessary at all seasons, but especially during the great heats of summer.

When the date-palm is raised from seed, it seldom produces fruit before it is twelve or fifteen years old. To obviate this inconveniency, the Arabs generally prefer the mode of propagation by shoots selected from the best and most flourishing trees. These shoots, with proper management, begin to bear fruit in three or four years, although it is not till the plant has reached its fifteenth or twentieth year that the fruit is in its highest degree of perfection, after which it is said that it continues to flourish vigorously for 200 or 300 years. The date crop is gathered about the end of November, and the bunches are hung up to dry in an airy situation. A very extensive trade in dates is carried on with the interior districts of Africa, and great quantities are exported to different parts of Europe. Plate 36. Fig. 3.

Elæis. *Gen. char.*—Diœcious, cal. and cor. six-cleft, fruit a drupe, three-valved, one-celled, and one-seeded.

El. *Guineensis*, Palm-oil Tree; with pinnated leaves, and footstalks, furnished on the edges with awl-shaped spines, some of which are hooked, some straight, and the lowest spreading and longest. This palm is a native of Guinea; the seeds being boiled in water yield the palm-oil, a valuable commercial commodity; and from the fermented liquid obtained by tapping the tree, palm wine is made.

Areca. *Gen. char.*—(1) Cal. two-valved, cor. with three sharp-pointed petals. (2) Cal. and cor. in the same sheath, fruit a roundish drupe, with a thick fibrous rind inclosing an oval nut.

Ar. *Oleracea*, Mountain Cabbage-tree; with leaflets quite entire. This tree, which is one of the most stately and most beautiful of the palm tribe, is a native of the West Indies, and common in many parts of Jamaica, where it grows to the height of 100 and of 150 feet. Near the ground it is often seven feet in circumference, and tapering as it ascends; the ash-coloured bark is changed into a deep sea-green at 20 or 30 feet from the top; and it is terminated by pinnated leaves, some of which are 20 feet long, with leaflets often three feet long. When the green bark immediately under the branches is removed, what is called the cabbage is discovered, in thin, snow-white, brittle flakes, which has been compared to the taste of an almond, but with greater sweetness. This part is eaten as cabbage is used in this country, and is considered what it really is—a delicious dish; but to obtain a single dish, a whole tree, or several trees, must be destroyed. Plate 36. Fig. 5.

Ar. *Catechu*, Betel-nut Tree; with pinnated leaves, leaflets opposite, bent back, and bitten off. This palm is a native of India, grows to a great height, and is terminated with six or eight pinnated leaves, each of which is about six feet long. The betel-nut forms an important object of trade in the east; it is employed as a luxury similar to that of tobacco in Europe, and for this purpose it is prepared by mixing it with the leaf of a species of pepper, which, from this use, has obtained the name of betel-leaf. The nut is cut in slices, sprinkled with slaked lime, and wrapped up in the pepper leaves. Other spices and aromatic drugs are employed in the preparation in some parts of India; and the chewing of betel is a very general practice throughout the east.

The wood of both species of Areca, which is hard and durable, is of great use to the inhabitants, as rafters for houses, pales for fences, and water-pipes and gutters.

Cocos. *Gen. char.*—Monœcious: (1) Cal. with three leaves, cor. with three petals. (2) Cal. with two leaves, and cor. with six petals; seed vessel a drupe, with a fibrous husk, including a large oval nut.

Cocos *Nucifera*, Cocoa-nut Tree; is a native of almost every tropical region; grows to the height of fifty or sixty feet, and is terminated by a bunch of ten or twelve leaves, from ten to fifteen feet long. The cocoa-nut tree is of slow growth, but when it reaches maturity it lives long, and produces fruit three or four times a year. By wounding the upper part of the tree, which is green and tender, a sweet thick liquor distils, of an agreeable flavour, and known in Ceylon by the name of tody, is a wholesome and cooling drink while fresh, and acquires, by fermentation, an intoxicating quality. Of the cocoa-nut tree it has been said, that it furnishes meat, drink, medicine, clothing, lodging, and fuel. The kernel of the nut is eaten; the milk is a cooling and pleasant beverage, which is sometimes employed as an emulsion in fevers; a fibrous substance at the base of the branch is converted into coarse cloth; the fibrous covering of the nut is manufactured into strong and durable cordage; the leaves are used as thatch, or made into mats for baskets; the woody part is applied to the purpose of lathing, and the polished shells are made into drinking cups. Plate 36. Fig 4.

Cocos *Guineensis*, Prickly Pole; with the whole plant covered with bristle-shaped spines; fronds distant, and root creeping. Native of the inland woods of Jamaica; rises to the height of forty feet; and thirty or forty trees grow together. This palm is remarkable for being thickly set with a vast profusion of long, sharp, tough spines, with which it is said the Indians arm their arrows.

Cocos *Aculeata*, Prickly Macaw Tree; with spindle-shape trunk, covered with spines. Native of Jamaica, and so called from a bird which feeds upon the fruit. The trunk of this palm is said to be as thick as the human body, grows thirty feet high, and is closely set with sharp black prickles, arranged in circles, and of various lengths.

Ceroxylon *Andicola*, Wax-palm; with simple stem, pinnated leaves, and paniculated spadix or flower-spike. This palm, which is described by Bonpland in his splendid botanical work, seems to be the loftiest vegetable production on the globe; it rises to the height of 200 feet, and is a remarkable exception to the tribe of palms, which are natives of warmer regions; for although it rears its majestic head on the mountain Quindiu, in north latitude 4° 35′, it grows at an elevation of nearly 6000 feet above the level of the sea, and is confined to a space of fifteen or twenty leagues. A peculiar matter, which, by chemical analysis, is found to be composed of two-thirds resin and one-third of a substance resembling wax, exudes from the trunk of the tree, and being collected by the inhabitants, is melted with tallow, and made into candles. From this production the generic name is derived; and the specific appellation is descriptive of its native station on the Andes.

Cycas. *Gen. char.*—(1) An imbricated catkin; cal. a sheathing scale; corolla none; anthers globular, attached to the scale, sessile. (2) Spadix or flower-spike compressed, double-edged; no calyx or corolla; style one; drupe, one-seeded.

Two species of this genus, *Circinalis* and *Revoluta*, both with pinnated leaves, are natives of India, Japan, and China, and afford the nutritious substance known in the shops under the name of Sago; but it appears that the production of sago is not confined to these species of palm, for it is obtained from others, and perhaps might be extracted from the whole of this singular tribe of plants.

The sago is the medullary part, or pith of the plant, which is formed into a paste with water, and

Palms.

when it begins to dry is granulated by passing it through a perforated plate; it is then dried, and appears in the form of roundish grains like seeds, for which it is taken by those who are unacquainted with the origin of this useful substance. Plate 36. Fig. 7.

Observation.—Six species only of the order of palms have been observed in New Holland; and, with the exception of one species in 34° south latitude, all within the tropic. No species were seen on any part of the south coast. Sir Jos. Banks discovered a species of Areca in New Zealand in 38° south latitude; which, it is probable, is nearly the limit of this tribe of plants in the southern hemisphere. In North America they have not been seen beyond 36° of latitude; but in Europe, *Chamærops Humilis* is a native of the vicinity of Nice. No species of palm has yet been discovered in Southern Africa or on the west coast of New Holland, even within the tropic.

Preparation of a Herbarium or Hortus Siccus.

Herbarium.

In prosecuting the knowledge of botany, it is recommended to the student, after being familiar with the terms and definitions, to compare, with the descriptions, those plants, the names of which he is acquainted with, or has an opportunity of learning from others. This preliminary exercise, as it may be called, will greatly abridge his labours, and enable him with more certainty and facility to refer to the class, order, genus, and species, such plants as are new or unknown to him. In botanical excursions a greater number of objects present themselves than can be conveniently examined on the spot; but by collecting plants in their own native soil and situation, many facts relative to their natural history are discovered; and for the purpose of subjecting them at leisure to future investigation, they are put up carefully in a close tin box, that those parts on which the characters depend may remain fresh and entire. The zeal of the enthusiast in botany is not to be limited by times or seasons; he will not fail to grasp at the objects of his pursuit when they are in his power; but when it is equally convenient, plants intended to be preserved are best collected in dry weather; and, when it can be accomplished, specimens in flower and in seed ought to be selected, that all the characteristic parts may be seen.

Plants are preserved by drying them slowly between the leaves of unsized porous paper, by the application of a hot smoothing iron, or in a box of sand. In the first case, the plants being spread carefully between the leaves of the paper, and retaining as much as possible their natural appearance, they are subjected to pressure, which at first should be moderate and afterwards gradually increased as the plants diminish in bulk by the absorption of the moisture. The pressure is applied either by means of a press constructed for the purpose, of two strong boards, of sufficient length and breadth to cover a large sheet of paper, and furnished at the corners with screws, or what answers equally well, a folio book placed upon the paper on a flat board or table, and loaded with other books. In preserving plants in this manner, when much nicety is required, every precaution should be observed not to wound or injure any of their parts by which a copious flow of the juices is produced. If a large quantity of paper be employed, the plants often dry perfectly without being shifted, but when they are crowded together in the same paper it is necessary to change their place, and at the same time to dry the paper daily.

The application of a hot smoothing iron answers, in some cases, sufficiently well, particularly for drying succulent or juicy plants; but it ought to be applied slowly and cautiously, and with a considerable quantity of paper.

The colour of some plants is retained in higher perfection by drying them in a box of sand. After the specimen has been pressed for ten or twelve hours according to the former method, it is placed within a sheet of blossom paper, and laid in the box on a layer, an inch thick, of fine dry sand, covered with another layer of the same thickness, on which another sheet of paper with plants is placed, and another layer of sand, till the box be full. The box is then set near a fire for two or three days, or till the plants be sufficiently dried.

Some vegetables are so tenacious of the vital principle, that they continue to grow during the process of drying; and others, as the heaths and firs, throw off their leaves. The immersion of the fresh specimen in boiling water, or the application of a hot-iron, counteracts both these effects; but even with every precaution, the colours of flowers, and the appearance of the leaves of many plants, undergo very great changes. Some yellow colours retain all their brilliancy and beauty; while others, as well as the whole plant, become black by drying. Blue colours generally fade; reds are not always permanent; and the natural aspect of most white flowers is altered.

When the specimens are dried, they are best preserved by securing them on paper with weak carpenter's glue, that they may be turned over without injury. When the stems are thick and heavy, the additional support of transverse slips of paper is necessary. A half-sheet of paper of a suitable size is to be allotted to each species; or, when the species occupies little room, two or more may be put upon the same half-sheet; and all the species belonging to the same genus are collected into one or more whole sheets; on the latter of which the name of the genus is written, and on the corner the name of the species, its place of growth, and other circumstances connected with its history. The specimens thus collected and arranged, are placed on shelves in a cabinet; and a dry room, without a constant fire, is recommended as most suitable for a herbarium.

The depredations of insects are peculiarly destructive to dried specimens, and especially *Ptinus fur*, a small beetle, deposits its eggs in the germens or receptacles of flowers, which are in a short time devoured by the maggots when hatched. To prevent their devastations, Dr Smith recommends a solution of corrosive sublimate of mercury in rectified spirits of wine, in the proportion of two drams to a pint, with the addition of a little camphor, as the most efficacious remedy. When the specimens are quite dry, and before they are pasted, the solution is applied with a camel-hair pencil. It is also found useful to mix a few drops of the solution with the glue which is employed for pasting the plants on the papers. This application, Dr Smith observes, not only keeps off all kinds of vermin, but greatly revives the colours of most plants, and gives the collection a pleasing air of freshness and neatness.

Chap. III. Structure and Functions of Vegetables.

The division of natural bodies into organised and inorganised, is sufficiently discriminative; the most perfect forms of inorganised matter exhibit no analogous characters to the varied and complicated structure of plants or animals. A striking diversity prevails in the mode of formation, or the growth and increase of the objects of these two great classes. In mineral bodies, the growth or increase is accomplished by the mere aggregation of the particles of matter already prepared, and according to the laws of affinity between these particles; and no new properties can be detected in the aggregate produced which are not found in the minutest particle of which it is composed. But in organised bodies, under which are comprehended vegetables and animals, the growth or increase is effected by a very different process. The substances of which they are composed are received into tubes or vessels, conveyed to all parts of the vegetable or animal, subjected in their progress to peculiar changes, and are converted into new forms, exhibiting properties and qualities which no chemical or mechanical operation could discover in the simple elements. New changes are produced, and new combinations are formed, none of which could be detected in the water, the earth, the air, the heat, or the light; all of which contribute their share to the progress and increase of organised bodies. Observing the remarkable diversity between the laws which regulate the operations of vegetables and animals and the established laws of chemical action, philosophers have naturally inferred the existence and influence of a different principle, called the *vital principle*, under whose power the wonderful and complicated phenomena of animals and vegetables are exhibited;—under whose power the effects of chemical or mechanical agents, which seem injurious, are counteracted;—under whose power what is beneficial is selected;—what is deficient is supplied, and what is redundant is cut off.

The division of organised bodies into vegetables and animals, although in both some points of resemblance may be traced, is, in general, sufficiently characteristic, when their form, structure, power of motion, constituent parts, and peculiar habits, are taken into consideration.

Sect. 1. *Of the Structure of Vegetables.*

A plant is composed of a root, stem, leaves, flowers, fruits, and seeds; and when these different parts are fully developed in the progress of vegetation, the plant is said to be perfect; when any of them are deficient or less obvious, it is called an imperfect plant. The root, concealed in the earth, conveys nourishment to the whole plant; the stem supports all the other parts, and when it is large and solid is called the trunk, which is divided into the wood and the bark; and the bark, forming the external covering, clothes the whole plant. The wood immediately under the bark is composed of concentric layers, which increase with the age of the tree; and the pith, a soft, spongy substance, occupies the centre of the stem. The leaves consist of fibres, arranged in a kind of net-work, which proceed from the stem and footstalks by which they are attached to the branches; the flowers are composed of different parts destined to the perfection of the the fruits and seeds; the fruits usually consist of a pulpy substance, containing numerous vesicles, traversed by great numbers of vessels, and seeds are constituted of a similar vesicular texture. Beside the parts now enumerated, plants contain different orders of vessels, as lymphatic vessels for the circulation of the sap, peculiar vessels which contain thick or coloured fluids, utriculi, or cells, and tracheæ, or spiral vessels.

Cuticle.—The bark is composed of three parts, the epidermis, parenchyma, and cortical layers. The epidermis, or cuticle, is a thin transparent membrane which forms the external covering of the bark, and is composed of fibres crossing each other. By means of this membrane, the plant is protected from the injuries of the air, and the processes of absorption and perspiration go on through its pores. It is of a very delicate texture on some plants, and coarse and thick on others, as on the trunk of the plane tree; readily peals off from some, as from the birch; and may be separated by maceration from others.

The cuticle is susceptible of extraordinary extension; for, during the growth of the plant, from the commencement of vegetation, it is stretched over its whole surface, without receiving any accession of matter, as the connection with the vascular or living part of the vegetable body seems to be altogether interrupted; but on the old trunks of most trees it may be observed to crack in all directions, and in many it is entirely obliterated.

In the currant tree, and in the elder, the cuticle is smooth, and scales off in large flakes; in the fruit of the peach, and the leaves of the mullein, it is covered with dense harsh wool; in the leaf of the white willow, it is of a silky texture; in the betony, and some other plants, it is extended into rigid hairs or bristles; on the fruit of the plum, and on many leaves, it is covered with a dry bluish powder, which repels the drops of rain; in the cork tree, the common maple, the Dutch elm, and the Constantinople hazel, the cuticle is covered with a singular fungous substance, well known as cork; and in grasses and reeds, siliceous earth has been detected by chemical analysis, and to this, no doubt, their hardness and fine polish are to be ascribed.

Cellular integument.—Under the epidermis or cuticle, a succulent cellular substance is deposited; it is usually of a green colour, at least in leaves and branches; exists almost universally; and has been observed in mosses and ferns. Leaves are composed almost entirely of a plate of this substance, covered on each side by the cuticle; and in this organ, the changes which are produced on the juices of plants, by light and air, are effected.

The bark.—Next to the cellular integument lies the bark, which in plants or branches of one year old consists of a single layer, scarcely to be distinguished from the wood; but in older branches, and the trunks of trees, the number of layers is equal to the number of years during which the plant has existed. The innermost layer is called *liber*. The bark is composed of numerous woody fibres, which chiefly run in a longitudinal direction, and when macerated in water exhibit a beautiful structure resembling net-work. The lace-bark tree, *Daphne laghetto*, a native of Jamaica, presents a remarkable example of this structure, which has been already noticed in the description of that plant.

The peculiar virtues or qualities of plants chiefly reside in the bark, and especially in those layers which are next to the wood; it is here that the resin of the fir, the astringent qualities of the oak, and the aromatic oil of the cinnamon, are found.

Wood.—The wood which lies immediately under the bark, is composed of numerous concentric layers which increase with the age of the plant, and may be separated into thinner layers, which consist of longitudinal fibres. The wood which is next the bark is softer and whiter, and is hence called *alburnum* or white-wood, and known to workmen by the name of Sap; the interior part of the trunk is browner and harder, and is denominated the perfect wood. In the laburnum the concentric layers which constitute the alburnum are yellowish, and the perfect wood is brown. A tranverse section of lignum-vitæ affords a good example of the same diversity of appearance.

Pith.—The medulla or pith occupies the centre of the trunk or stem of the plant, and in growing stems or branches is a tolerably firm juicy substance; but when the same parts are fully grown, it becomes extremely light and cellular. Many of the grasses and umbelliferous plants have always hollow stems, lined only with a thin smooth coating of pith. Of the nature and functions of the pith, physiologists have entertained very different opinions; some have supposed that it performs no important office in the economy of plants, and others regard it as the seat of life and the source of vegetation; but whatever be its nature and functions, as it is most vigorous and abundant in young and growing branches, it cannot be doubted that it performs some essential part. Mr Knight supposes that the pith is a reservoir of moisture to supply the leaves when an excess of perspiration takes place; but it has been remarked by Dr Smith, that all the moisture in the pith of a whole branch would be too little in some cases to supply one hour's perspiration of a single leaf.

Vessels of plants.—Plants are furnished with different kinds of vessels, which are distinguished from each other by their course, situation, and uses. The lymphatic vessels, which serve for the circulation of the sap, are chiefly distinguished in the woody part of the plant. The peculiar vessels which contain thick or coloured fluids lie immediately under the bark. Some of these proper vessels are placed between the cuticle and the bark; and some forming oval rings, and filled with the peculiar juices of the plant, are situated in the interior part of the bark.

Another set of proper vessels is distributed in the *alburnum*, nearer to the centre of the trunk, and sometimes in the perfect wood.

The *utriculi*, or cells, constitute another set of vessels, vary in form, colour, and magnitude in different vegetables, and exist in the roots, the bark, leaves, and flowers. They seem to resemble a flexible tube slightly interrupted with ligatures nearly at equal distances, while a free communication is preserved through its whole length. The tracheæ or spiral vessels appear in the form of fine threads, and may be drawn out to a considerable length without breaking. These vessels are very numerous in all plants, form a kind of ring underneath the bark, and are distributed in distinct bundles in trees, shrubs, and herbaceous plants. These spiral vessels are easily detected in succulent plants, as in the leaf stalks of elder, syringa, and other shrubs; and in many plants of a herbaceous nature, as in the pæony and many of the lily tribe.

Spiral vessels were supposed by Malpighi and Grew to be air vessels, performing a similar office in plants, to the lungs of animals; but from the curious experiments and observations of Mr Knight, the fluids destined to the nourishment of the plant being absorbed by the root, are conveyed to the leaves by these vessels; and from their situation near the pith he has given them the name of central vessels.

Seeds.—The seeds from which the future plant proceeds is composed of different parts; of these parts the embryo, or germ, to which Linnæus gave the name of *corculum*, or little heart, is the most essential. This part is sufficiently obvious in some seeds, as the bean, the pea, and the lupine; and its internal structure, before the commencement of vegetation, is very simple. The cotyledons, or seed-lobes, are immediately attached to the embryo, and indeed are to be considered as forming part of it. In most seeds the cotyledons are two in number; but some seeds, as those belonging to the grass and corn tribe, the palms, and some other plants, have only one cotyledon, while others have three or more; and hence the division of plants suggested by this peculiarity of structure in the seeds, into monocotyledonous, dicotyledonous and polycotyledonous. In those plants the seeds of which have only one cotyledon, the greater part of the substance of the seed is composed of a farinaceous, fleshy, or horny substance, called albumen or white. When seeds of this description germinate, the cotyledon never rises out of the ground, or performs the office of leaves; but in plants whose seeds have two cotyledons, they rise out of the ground, and being formed from the seed itself, are called seminal or seed leaves. In some cases the seed leaves wither and decay as soon as the other leaves begin to unfold; but in other cases they continue long, and remain green and vigorous after the plant has made considerable progress; this may be observed in the yellow lupine. The cotyledons are abundantly obvious in the garden bean after it has begun to vegetate, and the embryo is seen to push out from between them.

The appendages of many seeds, and the peculiar structure of some seed-vessels, are admirably calculated to promote their dispersion; for this purpose seeds are furnished with wings, spines, hooks, and scales. The downy appendage of many seeds of syngenesious plants, as is familiar to every one in the dandelion, wafts them through the air; the elastic power of the seed-pods of other plants, projects their contents to a considerable distance; and the barbed structure of some seeds retains them in the soil, while the uncoiling of the attached awn forces them deeper.

Sect. II. *Functions of Vegetables.*

When the perfect seeds of a plant are exposed to the influence of certain agents, they undergo a very remarkable change, in the progress of which, plants exactly similar to those from which they originated are produced.

Germination.—The first change which is observed in seeds when they are placed in certain circumstances, is called germination. Heat, air, and moisture, are necessary to this process. No vegetation whatever takes place when the temperature is at the freezing point, and very little till it rises many degrees above it. Air is no less requisite for the germination of seeds; when it is entirely excluded, as in the vacuum of an air pump, no change takes place. Moisture is also necessary in this process; but in most cases water must be applied in a regulated and moderate quantity,—for, excepting the seeds of aquatic plants, which possess peculiar habits, most seeds, when exposed to excessive moisture, are deprived of their vegetative power. The exclusion of light is favourable to the vegetation of seeds, and hence it is that their germination is greatly promoted by covering them with the soil.

When a seed begins to germinate, the first change observed is the increase of size by the absorption of moisture; the radicle, or little root, pushes out and stretches downwards into the earth, from which it conveys nourishment for the growth of the future plant. Another part, called *plumula*, shoots upwards, and finally expands into leaves and branches; but these remarkable effects are owing to certain changes which take place within the seed. The absorption of the oxygen of the atmosphere, the evolution of carbonic acid gas, by the combination of the oxygen with the carbone of the seed, and the conversion of the farinaceous matter into a saccharine substance, which is destined for the nourishment of the embryo plant, are the first changes observed in the germination of seeds. The cotyledons, or seed-lobes, are to be regarded as store-houses of food for the young plant, before the evolution of its parts are fully completed, to enable it to derive nourishment from the earth.

Roots.—The roots of plants are intended to retain them firmly in the soil, and at the same time to derive nourishment for their support. The root is composed of two parts, denominated *caudex*, or body, and *radicula*, or fibre, the latter of which, as it alone imbibes nourishment, is essential to the plant. The turnip and the carrot form the *caudex*, or body of the root, while the fibres which proceed from them are to be considered as the proper roots.

The fibrous extremities of roots, which draw nourishment from the earth, are produced annually, and these extremities have a peculiar structure; for when the extremities of the fibre are cut off, the vegetation of the plant ceases till new fibres are formed; and hence the practice of cutting off most of the fibres is in many cases extremely prejudicial. The peculiarity of structure alluded to may be observed in the fibres of bulbous roots which blow in water, in which case the extremity of each fibre seems to be included in a kind of fringed bag.

Stems, &c. of plants.—The stem, stalk, or trunk of a vegetable, thus variously denominated in different kinds of plants, forms a support for the leaves and flowers, and a necessary communication between the root and those parts which are elevated above the surface of the earth, and in which the most important functions of vegetation are accomplished. The stems of plants are not less various in form, magnitude, and consistence than the character and habits of the different kinds of vegetables to which they belong. This diversity affords many important distinctions for botanical classification, as well as many curious topics for physiological inquiry.

The branches of trees or shrubs, which constitute a minuter division of the trunk or principal stem of the vegetable, may be regarded as a new order of stems, whose roots are attached to a ligneous base, and thus form the necessary communication between the leaves and the source of nourishment.

The general aspect of a plant depends, in a great measure, on the distribution of the branches, as they spring from the trunk in a spiral direction, opposite to each other, in whorls, disposed irregularly, or from two sides of the trunk only, and form with it more or less acute angles. On the same plant the branches are observed to be arranged in very different, and almost opposite directions. In a large tree the lower branches are bent towards the earth, some spread out horizontally, and those towards the summit of the tree rise nearly in a perpendicular direction; but the disposition of the whole is such that the action of the air and light, of so much importance to the health and vigour of the vegetable, may be the least interrupted. Influenced by the same cause, a plant in a shady place inclines all its branches to that side where the action of air and light is most powerful; and plants, confined in a hot-house, turn all their leaves and branches towards that side from which the light proceeds.

According to Schabol, as quoted by Mirbel, five different kinds of branches may be distinguished in fruit-trees,—a distinction of no small importance in their culture and management. In the first kind the surface is smooth, the vessels run in a straight direction, and are easily separated; they bend without breaking straight across, and produce only wood. By practical gardeners such shoots are called the *wood*. 2. In the second kind of branches the base is wrinkled and perforated with small holes, the texture is more complicated, the vessels more numerous, and the juices of greater consistence; these are the fruit branches; they produce flower-buds, and break clean across when they are bent. 3. Another set of branches bear some resemblance to the first, but they are less permanent, because they have their origin only in the bark; they are denominated branches of *spurious wood.* 4. In the fourth order of branches the base is broad, the bark is brownish and rough, their buds are black and thinly set; they have their origin in the bark, and are nourished at the expence of the useful branches; they push out rapidly, and have a short duration. 5. The fifth kind of branches, which are not particularly characterised, are described as being useless to vigorous trees, and injurious to those whose vegetative powers are feeble. They draw to themselves a large portion of nourishment, and exhaust the vegetable on which they exist.

Buds.—As the trees of tropical regions, where vegetation is never interrupted, are destitute of buds, this part of the vegetable structure, in which the rudiments of a plant remain in a dormant state, till the influence of those agents which produce its evolution commences, is a necessary preservative in cold countries. The buds of trees and shrubs are formed during the summer in the bosoms of the leaves. In their structure and distribution they are remarkably uniform in the same species, but a great diversity prevails in their situation and forms in different tribes of plants. They are composed of a number of scales, which are closely wrapped upon each other, and unfold the embryo plant or branch. To enable them to accomplish the purpose for which they are destined, many buds are furnished with some additional covering, as a coat of wool, or of a gummy or resinous secretion. Thus constructed and protected, buds are enabled to resist very great degrees of cold; for it is only when the vegetative process has commenced, when they begin to unfold their leaves, that they sustain injury from the sudden changes of a variable climate.

Buds derive their origin from the *alburnum*, or white wood, according to the observations of Mr Knight; but perhaps this is liable to certain modifications, if the remarks of Schabol, formerly detailed, on the different kinds of branches be well founded. In some tribes of plants the same buds produce both leaves and flowers, but in others the leaves and flowers appear in different buds. The bulbs, or as they are, with little propriety, denominated roots, of certain tribes of plants, as the hyacinth, the lily, and the tulip, are true buds; and in some of them, as in the tulip, the future flower is distinctly formed, and only requires the influence of the necessary agents of heat, air, and moisture, for its complete evolution.

Every bud may be considered as a distinct individual performing its functions, when the influence of the proper agents is exerted, independent of the parent stem, or of any other part of the plant, excepting in the circumstance of deriving its nourishment from that source. Thus, if the branch of a vine, whose root is exposed to the open air, be introduced into a hot-house in the middle of winter, the vegetative process will immediately commence, and proceed with vigour, and if the proper temperature be continued, leaves, flowers, and fruit may be produced while every other part of the tree remains in a dormant state.

Leaves.—The leaves of plants, not only contribute to their beauty and elegance, but perform functions of essential importance in the process of vegetation. Deprived of its leaves, no tree brings its fruit to maturity, as is too often experienced in the ravages of the caterpillar on the gooseberry; and if by any accident a tree has lost its leaves, the progress of its growth is interrupted till it is again clothed with foliage.

A leaf is composed of a double layer of the fibres and vessels of the footstalk, between which is interposed a plate or layer of the *parenchyma* or cellular texture. Leaves, it has been long observed, and proved by decided experiments, transpire a considerable quantity of moisture, and in some cases this quantity was little inferior to the moisture absorbed. It is greatest during sunshine and warm weather, is much interrupted during the night, and entirely checked by cold. In an experiment by Dr Hales, a plant of sun-flower, *Helianthus annuus*, lost nearly two lbs. weight in twelve hours of a hot dry day; in a dry night, the diminution of weight was only about three ounces; in a moist night, no perceptible difference was observed; and in a rainy night it gained two ounces. The matter excreted by the leaves of plants is of very different qualities. In some it is aqueous, in some of a saccharine nature, and in others it is glutinous, resinous, or waxy.

The sap of plants flows from the root towards the branches and leaves; and in the leaves it undergoes peculiar changes, in consequence of part being exhaled, and of the absorption of different principles, which, combining with it, contribute to the changes that are effected. During these changes the peculiar juice of the plant is prepared, which, in its progress from the leaves towards the roots, deposits those ingredients which produce all the variety of substances which are detected by the remarkable diversity of odour, taste, and consistence. The exhalation of a portion of the moisture taken in by the roots, and the absorption and decomposition of carbonic acid gas, by which the carbone is retained in the plant and the oxygen is given out, constitute one part of the functions of leaves. These processes are most vigorous during the day, and particularly during bright sunshine; but in the night they are reversed. Carbonic acid gas is given out, and moisture and oxygen gas are absorbed; and this absorption and moisture is chiefly effected in many plants by the under surface of the leaves.

The effects of light on vegetables are very remarkable. When it is entirely excluded, although they enjoy the influence of air, heat, and moisture, they never acquire their rich green colour, but remain of a pale, sickly white. The familiar practice of blanching or whitening celery, affords a good illustration of this fact; and it is not only the colour, but the smell and taste undergo equal changes.

Sleep of plants.—When the influence of those agents which have a powerful effect on vegetables is withdrawn, many plants exhibit a very remarkable change in their aspect. This is particularly the case with plants which have pinnated leaves. During the night, and sometimes in dark cloudy weather, the leaves droop or fold over each other; this has been called the sleep of plants, and it has been supposed that it may be a kind of necessary repose in some way useful to the vegetable constitution. A similar change takes place in other plants from mechanical impulse, as in the sensitive plant: the leaves of which, by the slightest touch, close together, and exhibit the same appearance as those plants which are supposed to be under the influence of sleep.

Heat of plants.—During the chemical changes that take place in plants, it cannot be doubted that heat is evolved or abstracted; and it is extremely probable that plants, as well as animals, have the power of regulating, although in a lower degree, the excesses of temperature to which they are exposed. The snow which falls on the leaves and stems of living plants melts sooner than on dead matter of the same kind,—an obvious proof that the temperature is higher; but the heat of vegetables is so much superior to that of the atmosphere, as to be indicated by the thermometer. A remarkable fact is stated by Senebier with regard to the increased temperature of the white-veined variety of the *Arum maculatum* in a certain period of its growth, when the flower was for a few hours very hot; it was perceptible from three or four o'clock in the afternoon till 11 or 12 at night; and when the temperature of the air was 14 or 15 degrees of Reaumur's thermometer, the heat of the plant, when it was highest, was seven degrees above it. This curious fact, as is justly observed by Dr Smith, is well worthy of attention, and may perhaps be observed in other plants.

Duration of plants.—Many plants, as soon as they have ripened their seeds, which is accomplished by some in one season, by others in two, cease to vegetate; and hence such plants have been denominated *annuals* and *biennials*,—terms expressive of their duration for one or two years; but other plants live for a great length of time, and continue to produce seeds and fruit for many successive seasons; and hence such plants have been called *perennials*. This diversity of duration exhibits a wonderful and endless variety among the vegetable tribes. The humble annual springs up, displays its leaves, and flowers, and forms perfect seeds, and thus, within the short period of a few months, passes through the whole progress of its existence; while the stately oak rears its lofty head, and continues to be the glory and pride of the forest for hundreds of years.

Those who wish to extend their knowledge of the structure and functions of plants may consult with advantage, *Senebier Physiologie Vegetale;* Mirbel on the same subject; Smith's Introduction to Botany; Willdenow's Introduction; and, for the classification and description of plants, Willdenow's Species Plantarum, Brown's *Prodromus Plant. Nov. Holland;* and the Appendix to Flinder's Voyage, by the same excellent botanist; and, for British plants, Smith's *Flora Britannica*, Withering's Botanical Arrangement, and Lightfoot's *Flora Scotica.*

Explanation of Plates.

Plate 28. Fig. 1—61. Illustration of the Linnæan system, to which particular references are made at page 711.

Plate 29. Fig. 1—69. exhibits a view of the forms of Simple Leaves, the names of which, and the individual references, will be found at page 712.

Plate 30. Fig. 1—23. presents a view of the Forms of Compound Leaves. See page 713.

Plate 31. Fig. 1. *Canna Indica*, Common Indian Reed. Fig. 2. *Verbena Aubletia*, Rose Vervain. Fig. 3. *Iris Lurida*, Dingy Flag. Fig. 4. *Banksia Ericifolia*, Heath-leaved Banksia. Fig. 5. *Crassula Coccinea*, Scarlet-flowered Crassula. Fig. 6. *Stapelia Grandiflora*, Great-flowered Stapelia. Fig. 7. *Agave Americana*, American Aloe. Fig. 8. *Disandra Prostrata*, Trailing Disandra.

Plate 32. Fig. 1. *Fuchsia Coccinea*, Scarlet Fuchsia. Fig. 2. *Dionœa Muscipula*, Venus' Fly-trap. Fig. 3. *Melastoma Tomentosa*, Woolly Melastoma. Fig. 4 . *Cephalotus Follicularis*, Pitcher Plant. Fig. 5. *Metrosideros Citrina*, Harsh-leaved Metrosideros. Fig. 6. *Liriodendron Tulipifera*, Common Tulip-tree. Fig. 7. *Bignonia Radicans*, Ash-leaved Trumpet-flower. Fig. 8. *Pelargonium Incrassatum*, Fleshy-leaved Pelargonium or Crane's-bill. Fig. 9. *Hedysarum Gyrans*, Moving Plant.

Plate 33. Fig. 1. *Theobroma Cacao*, Cacao or Chocolate Tree. Fig. 2. *Chrysanthemum Tricolor*, Three-coloured Chrysanthemum. Fig. 3. *Rudbeckia Purpurea*, Purple Rudbeckia. Fig. 4. *Echinops Ritro*, Small Globe Thistle. Fig. 5. *Cypripedium Parviflorum*, Yellow Ladies-slipper. Fig. 6. *Epidendrum Sinense*, Chinese Epidendrum. Fig. 7. *Passiflora Serratifolia*. Notch-leaved Passion-flower.

Plate 34. Fig. 1. *Myristica Moschata*, Nutmeg Tree. Fig. 2. *Artocarpus Incisa*, Notch-leaved Bread-fruit Tree. Fig. 3. *Mimosa Nilotica*, Gum-Arabic Tree. Fig. 4. *Ficus Indica*, Banyan Tree. Fig. 5. *Musa Paradisaica*, Plantain Tree.

Plate 35. Fig. 1. *Asplenium Palmatum*, Palmated Spleenwort. Fig. 2. Single frond of *Lonchitis Pedata*, Pedated Rough Spleenwort. Fig. 3. Entire Plant. Fig. 4. *Lindsæa Reniformis*, Kidney-shaped Lindsæa. Fig. 5. *Blechnum Boreale*, Rough Spleenwort. Fig. 6. *Scolopendrium Vulgare*, Common Hart's-tongue. Fig. 7. *Polypodium Phegopteris*, Pale Mountain Polypody. Fig. 8. *Aspidium Aculeatum*, Common Prickly-shield Fern. Fig. 9, 10, 11, 12, 13, different Specimens of *Fuci*. See page 757.

Plate 36. Fig. 1. *Ceroxylon Andicola*, Wax Palm. Fig 2. *Cocos Guineensis*, Prickly-pole Palm. Fig. 3. *Phœnix Dactylifera*, Date Palm. Fig. 4. *Cocos Nucifera*, Cocoa-nut Tree. Fig. 5. *Areca Oleracea*, Mountain Cabbage Palm. Fig. 6. *C. Hamerops Humilis*, Fan Palm. Fig. 7. *Cycas Circinalis*, Sago Palm.

Plate 37, Fig. 1. a, a, a, a, exhibit the regular hexagons of a transverse section of the cellular texture; b, b, the same appearance in a vertical section; c, c, represent the sides of the cells common to contiguous cells. Fig. 2. The same drawn out, and a little more porous. Fig. 3. Perforated with pores arranged

Genera.

in transverse series. Fig. 4. Large porous tubes. Fig. 5. Tubes divided, or false tracheæ. Fig. 6. Hexahedral cell interrupted by membranes. Fig. 7. Spiral vessel drawn out, with the pores arranged transversely. Fig. 8. a, the point from which the radicle of the garden bean proceeds. Fig. 9. exhibits the coats, lobes, and vessels of the bean. Fig. 10. and 11. The lobes separated, with the plumula and radicle. Fig. 12. Ramifications of the seminal roots in the lobes. Fig. 13. The same appearance with the radicle farther advanced. Fig. 14. The radicle throwing out fibres, and the plumula cut transversely to shew the vessels. Fig. 15. Seed leaves of the cucumber, and the first appearance of the plumula. Fig. 16. The same seed at an earlier period, when the radicle only appears. Fig. 17. The same seed farther advanced, and the seed leaves beginning to separate. Fig. 18. a, a, a, transverse section of the footstalk of the leaf of *Acrostichum aureum*; b, b, b, b, vertical section. Fig. 19. Magnified view of a section of the sugar cane. Fig. 20. Magnified view of the common cane. Fig. 21. Magnified view of the gooseberry cut transversely. Fig. 22. Transverse section of the garden bean in the pod, magnified.

GENERA ILLUSTRATED IN THE PRECEDING TREATISE, ARRANGED UNDER THEIR CLASSES.

Genera.

Fuchsia, Fuchsia.
Erica, Heath.
Daphne, Mezereon, or Spurge Olive.
Mœhringia, Mountain Chickweed.
Paullinia, Supple Jack.
Coccoloba, Seaside Grape.
Polygonum, Persicaria, or Bistort.
Paris, Herb Paris.
Adoxa, Moschatel.

IX. Enneandria. Page 728.

Laurus, Bay, Cinnamon, and Camphor Tree.
Anacardium, Cashew-nut Tree.
Rheum, Rhubarb.
Butomus, Flowering Rush.

X. Decandria. Page 729.

Sophora, Sophora, or Bead Tree.
Cæsalpinia, Brazil Wood.
Hæmatoxylon, Logwood.
Swietenia, Mahogany Tree.
Guaiacum, Lignumvitae.
Ruta, Rue.
Quassia, Quassia Tree.
Dionæa, Venus' Fly Trap.
Melastoma, Melastoma, or Indian Currant Bush.
Andromeda, Wild Rosemary, or Sorrel Tree.
Rhododendron, Rhododendron.
Kalmia, Kalmia.
Arbutus, Arbutus, or Strawberry Tree.
Hydrangea, Hydrangea.
Saxifraga, Saxifrage.
Dianthus, Clove or Pink.
Stellaria, Chickweed and Stichwort.
Arenaria, Sandwort.
Sedum, Stonecrop.
Oxalis, Wood Sorrel.
Agrostemma, Corn Cockle.
Lychnis, Catchfly, and Campion.
Cerastium, Mouse-ear Chickweed.
Spergula, Spurrey.
Phytolacca, Redweed, or Spanish Calalue.

XI. Dodecandria. Page 733.

Asarum, Asarabacca.
Rhizophora, Mangrove.
Lythrum, Loose-strife.
Halesia, Snowdrop Tree.
Heliocarpus, Sunseed.
Agrimonia, Agrimony.
Reseda, Dyer's Weed, and Mignonette.
Euphorbia, Spurge.
Cephalotus, Pitcher-plant.
Sempervivum, House-leek.

XII. Icosandria. Page 734.

Cactus, Creeping Cereus, or Melon Thistle.
Philadelphus, Mock Orange.
Myrtus, Myrtle, and Jamaica Pepper Tree.
Eucalyptus.
Metrosideros.
Psidium, Guava Tree.
Amygdalus, Almond and Peach Tree.
Prunus, Sloe and Plum Tree.
Mespilus, Hawthorn and Medlar Tree.
Pyrus, Pear and Crab Tree.
Mesembryanthemum, Fig Marygold.
Spiræa, Dropwort and Meadowsweet.
Rosa, Rose Tree.
Rubus, Raspberry and Bramble.
Fragaria, Strawberry.
Potentilla, Silver Weed.
Geum, Avens, or Herb Bennet.
Calycanthus, Allspice Tree.

XIII. Polyandria. Page 736.

Papaver, Poppy.
Cistus, Rock-rose.
Capparis, Caperbush.
Sanguinaria, Bloodwort.
Sarracenia, Side-saddle Flower.
Nymphæa, Water lily, or Lotus.
Tilia, Lime or Linden Tree.
Corchorus, Broomweed or Jews Mallow.
Thea, Tea Tree.
Bixa, Annotto.
Pæonia, Pæony Rose.
Delphinium, Lark's Spur.
Aconitum, Monks-hood.
Wintera, Winther's Bark Tree.
Aquilegia, Colombine.
Stratiotes, Water Soldier.
Anemone, Anemone, or Pasque-flower.
Ranunculus, Ranunculus, Spearwort and Pilewort.
Liriodendron, Tulip Tree.
Annona, Sour and Sweet Sop.

XIV. Didynamia. Page 738.

Ajuga, Bugle.
Teucrium, Wood sage.
Mentha, Mint.
Lamium, Dead-nettle.
Stachys, Hedge-nettle or Woundwort.
Prunella, Selfheal.
Rhinanthus, Horse-rattle.
Euphrasia, Eyebright.
Antirrhinum, Snapdragon.

Genera.

Digitalis, Foxglove.
Linnæa, Linnæa.
Bignonia, Trumpet-flower.
Crescentia, Calabash Tree.
Melianthus, Honey-flower.

XV. Tetradynamia. Page 739.

Draba, Whitlowgrass.
Thlaspi, Shepherds Purse.
Lunaria, Moonwort or Satin-flower.
Crambe, Sea-kale.
Lepidium, Garden Cress.
Cochlearia, Scurvygrass.
Iberis, Candytuft.
Cardamine, Lady's Smock.
Sisymbrium, Water-Cress and Isle of Man Rocket.
Erysimum, Hedge Mustard, or Yellow Rocket.
Cheiranthus, Wallflower.
Brassica, Rape, Turnip, Cabbage.
Sinapis, Mustard, Charlock.
Raphanus, Wild Radish, or Jointed Charlock.

XVI. Monadelphia. Page 740.

Tamarindus, Tamarind Tree.
Sisyrinchium.
Ferraria, Tiger-flower.
Erodium, Stork's-bill.
Pelargonium, Crane's-bill.
Aitonia, Aitonia.
Geranium, Geranium or Crane's-bill.
Bombax, Cotton Tree.
Gossypium, Cotton Plant.
Malva, Mallow.
Lavatera, Lavatera or Tree Mallow.
Hibiscus, Syrian Mallow, and Indian Sorrel.
Camellia, Japan Rose.
Alcea, Hollyhock.

XVII. Diadelphia. Page 742.

Fumaria, Fumitory.
Polygala, Milkwort.
Spartium, Broom.
Ulex, Furze, or Whin.
Hedysarum, Saint Foin.
Lupinus, Lupine.
Pisum, Pea.
Phaseolus, Kidney Bean.
Lathyrus, Sweet Pea.
Vicia, Vetch and Bean.
Trifolium, Trefoil.
Indigofera, Indigo Plant.
Cytisus, Laburnum, or Trefoil Tree.

XVIII. Polyadelphia. Page 743.

Theobroma, Chocolate-nut Tree.
Monsonia, Monsonia.
Citrus, Citron, Orange, Lemon, &c.
Melaleuca, Cajeput Tree.
Hypericum, St John's Wort.

Genera.

XIX. Syngenesia. Page 743.

Leontodon, Dandelion.
Hieracium, Hawkweed.
Arctium, Burdock.
Carduus, Thistle.
Eupatorium, Hemp Agrimony.
Bellis, Common Daisy.
Chrysanthemum, Ox-eye Daisy.
Solidago, Golden-rod.
Senecio, Groundsel.
Tussilago, Colt's-foot.
Aster, Starwort.
Anthemis, Camomile.
Achillea, Sneezewort.
Centaurea, Knapweed, or Blue-bottle.
Rudbeckia, Rudbeckia.
Helianthus, Sun-flower, or Jerusalem Artichoke.
Calendula, Garden Marygold.
Echinops, Small Globe Thistle.

XX. Gynandria. Page 745.

Orchis, Butterfly-flower.
Ophrys, Twayblade.
Cypripedium, Ladies Slipper.
Limodorum, Limodorum, or Jamaica Saloup.
Epidendrum, Epidendrum, or Vanilla.
Nepenthes, Nepenthes.
Passiflora, Passion-flower.

XXI. Monœcia. Page 746.

Zannichellia, Horn Pond-weed.
Artocarpus, Bread-fruit Tree.
Lemna, Duckweed.
Sparganium, Bur-reed.
Carex, Sedge Grass.
Typha, Cat's-tail.
Hernandia, Jack-in-a-box Tree.
Urtica, Nettle.
Buxus, Box-tree.
Betula, Birch and Alder Tree.
Morus, Mulberry and Fustick Tree.
Amaranthus, Amaranth, or Calalue
Fagus, Chesnut and Beech Tree.
Quercus, Oak Tree.
Juglans, Walnut Tree.
Corylus, Hazel-nut Tree.
Calla, Calla.
Arum, Arum, or Wake-robin.
Pinus, Pine, or Fir Tree.
Ricinus, Castor-oil nut Plant.
Jatropha, Cassada Plant.
Hura, Sand-box Tree.
Hippomane, Manchineal Tree.
Cucumis, Cucumber and Melon.

XXII. Diœcia. Page 750.

Vallisneria, Vallisneria.
Salix, Willow.
Empetrum, Crow Berry.
Ruscus, Butcher's Broom.
Viscum, Misseltoe.
Myrica, Gale and Candle-berry Myrtle.
Trophis, Ramoon Tree.
Cannabis, Hemp.
Humulus, Hop Plant.
Myristica, Nutmeg Tree.
Populus, Poplar Tree.
Rhodiola, Rose-root.
Mercurialis, Dog's Mercury.
Carica, Papaw Tree.
Juniperus, Juniper.
Taxus, Yew Tree.

XXIII. Polygamia. Page 752.

Musa, Plantain and Banana.
Mimosa, Gum Arabic Tree, Sensitive Plant.
Atriplex, Orache, or Sea Purslane.
Ficus, Fig and Banyan Tree.

XXIV. Cryptogamia. Page 753.

Equisetum, Horse-tail.
Ophioglossum, Adder's-tongue.
Osmunda, Moonwort, or Flowering Fern.
Lycopodium, Club-moss.
Polypodium, Polypody.
Aspidium, Male, or Shield Fern.
Blechnum Rough Spleenwort.
Scolopendrium, Hart's-tongue.
Asplenium, Sea Spleenwort.
Lonchitis, Hairy Spleenwort.
Adiantum, Maiden-hair.
Lindsæa, Lindsæa.
Pteris, Brakes.
Sphagnum, Bog Moss.
Phascum, Earth Moss.
Gymnostomum, Beardless Moss.
Splachnum, Gland Moss.
Encalypta, Extinguisher Moss.
Trichostomum, Fringe Moss.
Tortula, Screw Moss.
Orthotrichum, Bristle Moss.
Neckera, Neckera.
Mnium, Spring Moss.
Funaria, Cord Moss.
Bartramia, Bartramia.
Polytrichum, Hair Moss.
Jungermannia, Star-tip.
Marchantia, Liver-green.
Lichen, Liverwort.
Fucus, Sea-weed.
Agaricus, Mushroom.
Lycoperdon, Truffle, Puff-ball.

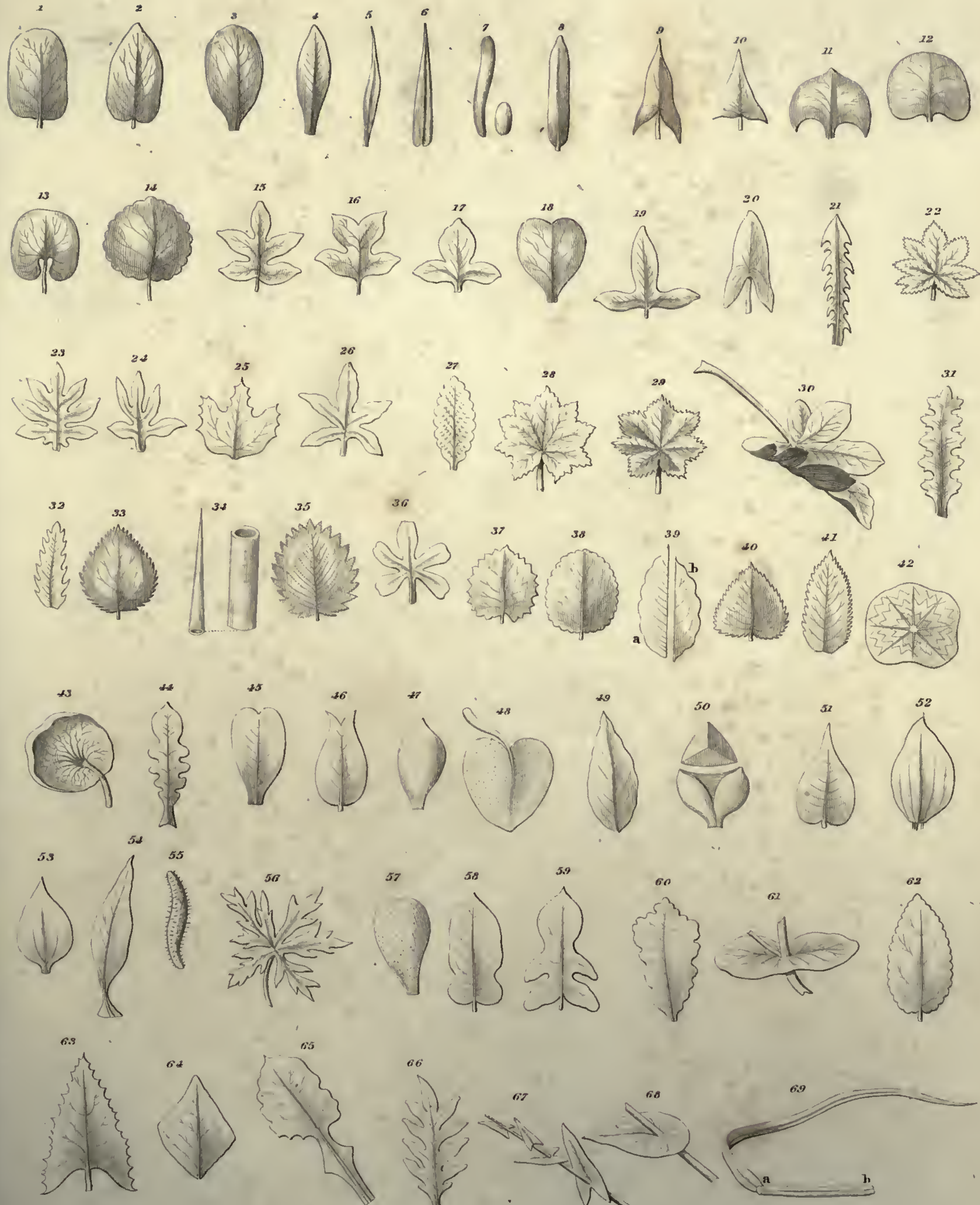
Palms.

Chamærops, Dwarf Palm.
Thrinax, Palmeto Royal.
Borassus, Fan Palm.
Corypha, Mountain Palm.
Phœnix, Date Palm.
Areca, Mountain Cabbage, Betel Nut.
Cocos, Cocoa-nut, Prickly Pole.
Ceroxylon, Wax Palm.
Cycas, Sago Palm.

Genera.

INDEX.


CLASS I
II
III
IV
V
VI
VII
VIII
IX
X
XI
XII
XIII
XIV
XV
XVI
XVII
XVIII
XIX
XX
XXI
XXII
XXIII
XXIV


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
a
b
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
a
b


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
23
22

1. Canna Indica.
2. Verbena Aubletia.
3. Iris Lurida.
4. Banksia Ericifolia.
5. Crassula Coccinea.
6. Stapelia Grandiflora.
7. Agave Americana.
8. Disandra Prostrata.

Drawn & Engraved by W. & D. Lizars for the Encyclopædia Edinensis.

. *Fuchsia Coccinea*
. *Dionæa Muscipula*
. *Melastoma Tomentosa*

4. *Cephalotus Follicularis*
5. *Metrosideros Citrina*
6. *Liriodendron Tulipifera*

7. *Bignonia Radicans*
8. *Pelargonium Incrassatum*
9. *Hedysarum Gyrans*

1. *Theobroma Cacao.*
2. *Chrysanthemum Tricolor.*
3. *Rudbeckia Purpurea.*
4. *Echinops Ritro.*
5. *Cypripedium Parviflorum.*
6. *Epidendrum Sinense.*
7. *Passiflora Serratifolia.*

Drawn & Engraved for the Encyclopaedia Edinensis by W. & D. Lizars Edinburgh.

1. *Myristica Moschata*
2. *Artocarpus Incisa*

3. *Mimosa Nilotica*
5. *Musa Paradisiaca*

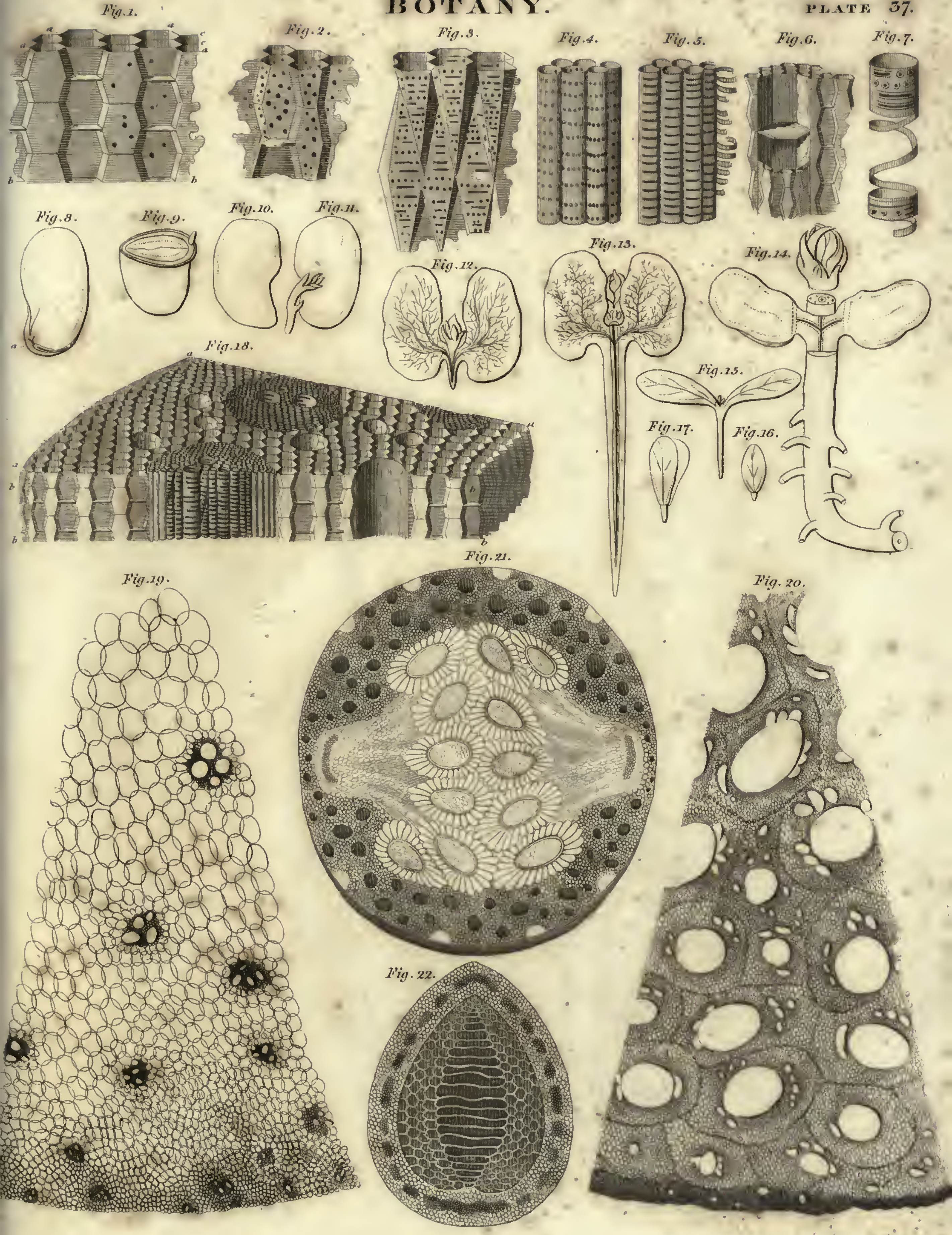
Fig. 4.
FICUS INDICA or BANYAN TREE.


Fig. 1.
FERNS
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 10.
FUCI
Fig. 11.
Fig. 12.
Fig. 13.

PALMS.

1. Ceroxylon Andicola.

4. Cocoa-nut Tree.
5. Cabbage Tree.
6. Fan Palm.



Drawn & Engraved for the Encyclopædia Edinensis by W. & D. Lizars Edinburgh.

BOTANY-BAY, a spacious bay on the south-east coast of New Holland, which derived its name from the great profusion of plants which were found by the naturalists who first visited that distant region. See New Holland.

BOTARGO, a peculiar kind of sausage, which is made of the milts and roes of the mullet, a fish which is common in the Mediterranean. This kind of sausage, which is usually eaten with olive oil and lemon juice, is in great request in the southern parts of Europe.

BOTHNIA, a province or district of Sweden, which is divided into two parts, denominated from their position East and West Bothnia.

East Bothnia, which stretches along the east side of the gulph of the same name, is about 300 miles long, and varies from 70 to 200 miles in breadth. A mountainous ridge forms the eastern boundary between Russia and Finland Proper. On the southern coast the land is low and marshy, but in some places the soil is remarkable for its fertility; and from the great length of the days in the middle of summer, or rather from the absence of night during that period, for the sun is visible for some weeks at midnight, corn has been known to ripen in six or seven weeks. The lakes and rivers abound with salmon. The population is estimated at 80,000; and fishing and agriculture afford the chief occupations to the inhabitants. Cattle, butter, dried salmon, pitch, tar, and timber, are enumerated as the principal exports.

West Bothnia lies on the west side of the gulph of Bothnia, and is bounded on the north and west by Lapland, and on the south by Angermannia. This district is in many places mountainous, but in others the soil is fertile and productive. The labours of agriculture, fishing, hunting, and the working of mines of copper and iron, chiefly occupy the industry of the inhabitants. Beside the commodities enumerated among the exports of East Bothnia, the skins of various wild animals, as those of the black and blue fox, the bear and wolf, the ermine, and the rein-deer, furnish the materials of a profitable commerce to the inhabitants of this district. Umea, Lulea, and Tornea, are the principal towns.

BOTHNIA, Gulph of, a branch of the Baltic, which is bounded on all sides by the territory of Sweden, excepting on the south, where the isles of Aland form the separation between this gulph and the Baltic sea. The length from north to south is estimated at 350 miles, and the breadth from east to west from 50 to 140 miles. In the winter season it is often frozen over, and thus forms an easy communication between the opposite coasts.

BOTTLE, supposed to be derived from a barbarous Latin word, is a small vessel for containing liquors, which, in different nations and periods of society, has been constructed of leather, stone-ware, and glass. The skins of animals seem to have been universally employed by the earlier inhabitants of eastern countries; and among the Jews, from the allusions in Scripture, it appears to have been the common practice; and hence the expression used by our Saviour, of "putting new wine into old bottles," from the danger of bursting by fermentation and increase of bulk, admits of an obvious explanation.

Earthen jars were employed by the ancient Romans for preserving their wine. The use of glass for this purpose has not been traced farther back than the 15th century. Common bottles, so universally employed in all European countries, and forming an extensive branch of manufacture, are made of coarse, greenish-coloured glass. Glass bottles of a finer quality, and thinner in the sides, are secured from external injury with a covering of twisted straw, or wicker-work, and then come under the denomination of flasks; such are the thin bottles which are brought from the southern parts of Europe with olive oil.

BOTTOMRY, a term in commercial affairs, which denotes a kind of contract, in the form of a mortgage of a ship, by which the owner of the vessel borrows money to enable him to complete the voyage, and pledges the keel or bottom of the ship, from which circumstance the contract derives its name, as a security for repayment. A contract of this nature, as in many cases it must be highly beneficial to trade, is allowed to be valid among all commercial nations. If the ship be lost the lender loses his money, but if it return in safety the principal as well as the premium or interest agreed upon, however it may exceed the legal rate of interest, is repaid. In this case, the ship and tackle, as well as the person of the borrower, are answerable for the money lent. But if security for the loan be given on the goods and merchandise which are to be sold or exchanged in the course of the voyage, then the borrower only is personally bound to fulfil the contract; and, in such a case, he is said to take up the money at *respondentia.*

Contracts of this kind were not unknown to the ancients; and laws for their regulation, enacted by the Romans, are still extant. In modern times, and particularly in Britain, contracts of bottomry and respondentia have been the subjects of legislative regulation. See Marshall on *Insurance;* Parke on *Marine Insurances;* and Jacob's *Law Dictionary.*

BOTTS, a kind of worms which are produced in the intestines of the horse, and which appear to be the *larvæ* of the gad-fly. See *Oestrus* under Entomology.

BOUGUER, Peter, an eminent French mathematician and natural philosopher, was born at Croisic, in the department of Lower Loire, in 1698, early commenced the study of mathematics under the tuition of his father, who was royal professor of Hydrography, and in his fifteenth year succeeded, on the death of his father, to the same situation, the duties of which he is said to have performed with great ability. A memoir on the Masting of Ships, presented to the Academy of Sciences in 1727, entitled him to the prize offered by that learned body for the best treatise on this subject; and in two years afterwards he was honoured with a similar mark of distinction for his memoir on the best method of ascertaining the height of the stars at sea.

In the year 1730 M. Bouguer removed to Havre; in 1731 was appointed associate geometer; and in 1735 was nominated pensioner astronomer. In the same year he embarked with his associates, Godin, Condamine, and Jussieu, for South America, for the purpose of measuring a degree of the meridian; and after an absence of nine years, during which he and his companions experienced the severest hardships and privations on the heights of the Andes, he returned to Europe in 1744. Five years afterwards he published his great work on the figure of the earth, determined from the observations made in Peru, and was involved in a controversy with his fellow traveller Condamine, who charged him with partiality in the distribution of the merit due to his associates in the undertaking. Condamine succeeded in securing the largest portion of the favour of the public who took any part in the dispute. Bouguer, who, it is said, was of a suspicious and envious disposition, was severely mortified at the issue of this controversy, and suffered much in his bodily health. He died in 1758, when he had reached the 60th year of his age. Beside the works already alluded to, he was the author of various treatises connected with physics and navigation, which appeared in a separate form, or in the Memoirs of the Academy.

BOULACK, or BULAK, a town of Egypt, which stands on the banks of the Nile, two miles west from Grand Cairo, has become a place of considerable commercial importance, and is the chief port of Lower Egypt. A customhouse, a spacious bazar or market-place, magnificent public baths, and magazines or warehouses for the accommodation of merchants, are the principal public buildings. The surrounding country is covered with beautiful gardens, which afford an abundant supply of delicious fruits, and all kinds of useful vegetables. But the invasion of Egypt by the French in 1799 was fatal to this town, for it was almost entirely destroyed by their army.

BOULOGNE, called also BOULOGNE SUR LA MER, from its situation on the sea-coast, a seaport town in the department of the straits of Calais in France, and formerly the capital of the province of Boulognois in Picardy. Boulogne is a place of great antiquity. It is supposed to be the *Portus Iccius* of Julius Cæsar, from which he embarked for the invasion of Britain; a light-house, or pharos, built by Caligula, was repaired by the emperor Charlemagne in the beginning of the ninth century, but was at last neglected, and about the middle of the 17th century became a heap of ruins.

Boulogne stands at the mouth of the river Liane, and is divided into an upper and lower town; the former is on the declivity of a mountain, is surrounded with a wall, and, before the revolution, was chiefly inhabited by the nobility. The lower town, occupied by persons engaged in trade, is nearer the sea, and is of an irregular form, with narrow winding streets. The harbour is of small extent, and is defended by a fort and batteries; but the entrance is incommodious, the depth of water small, and the roadstead is unprotected and insecure. The inhabitants are estimated at 10,000, a large proportion of which is occupied in the herring and mackarel fishery, which, for nearly three centuries, has been an object of importance to this place. Some manufactures of woollen and linen are carried on; but the exportation of Burgundy and Champaigne wines, and the smuggling of brandy, cambric, and other contraband goods, to the shores of Britain, constitute the greater part of its commerce. Boulogne is 20 miles S. E. from Calais, and 55 miles N. E. from Paris.

BOUNTY, a premium, or pecuniary reward, paid out of the public revenue, for the encouragement of navigation and shipping, or particular branches of agriculture or trade; of the first kind are the bounties which are paid for the encouragement of the whale and herring fishery; and of the latter description are those which are allowed for the exportation of grain in certain cases, and for the encouragement of rising manufactures. Of the beneficial effects of premiums of this description some diversity of sentiment prevails; but, in general, the opinions of the most respectable writers on political economy are unfavourable to the practice. This subject is fully discussed in the works of Dr Smith and Mr Malthus.

BOURBON, an island in the Indian ocean, in south latitude 20° 52′, and east longitude 55° 30′, about 100 miles S. W. from Mauritius, and 360 east from Madagascar. When it was first discovered by the Portuguese it was called Mascarenhas. The greatest length of this island is stated at 14 leagues, and the circumference pursuing the windings of the coast, is nearly 40 leagues. The surface of the island of Bourbon is said to be chiefly composed of two volcanic mountains, one of which rises 9000 feet above the level of the sea. The mountain called Gros Morne towards the northern part of the island has never been known, since its discovery by Europeans, to be in a state of activity, and its sides are clothed with luxuriant vegetation. But scarcely a year passes without a furious eruption from the mountain called Volcano in the southern district, and its ravages are strongly marked by the sterility and desolation of the surrounding territory, which is expressively denominated the *burnt land*.

The great inequality of surface produces great diversity of climate. The lofty peaks of the mountains are covered with snow in the winter season; in a lower region the agreeable coolness of the temperate zones prevails, while the full influence of a vertical sun is felt on the sea-coasts. A lake, half a mile in diameter, occupies the central part of the island, and seems to depend for the supply of its waters on the rains, for in some seasons it is quite dry. The rivers also derive their waters from the same source, or from the melting of the snows on the elevated summit of the mountains. Two remarkable plains lie between the loftier mountains. The plain Des Cafres, rising between 3000 and 4000 feet above the level of the sea, presents a desolate aspect; a few diminutive shrubs and stunted heaths are its only productions. But the Plain of Palms, so named from the profusion of mountain cabbage, or betel-nut palms, which cover its surface, is adorned with all the luxuriance of the richest vegetation. Hurricanes, as in other tropical regions, annually produce their destructive ravages in the isle of Bourbon.

All the fruits of tropical countries are abundant; and coffee, sugar, cotton, and cloves, are successfully cultivated. Corn and rice are raised in considerable quantities; a large proportion of which is exported to the Mauritius to supply its inhabitants with provisions.

The population of Bourbon in 1717 was estimated at 2000, of which 900 were whites and free persons, and 1100 were slaves; but in 1810, when it fell under the dominion of Great Britain, the number of inhabitants was computed at 90,000, of which 16,000 are stated to be whites and free persons of colour, more than 3000 free blacks, and above 70,000 slaves. Bourbon is divided into eleven parishes. St Denis is the capital of the island, and the residence of the governor; but in the number of its houses it merits no higher distinction than that of a village. Similar villages are set down in other parts of the island. The trade of Bourbon is carried on with Mauritius and Madagascar, the other islands in the Indian ocean, and the settlements on the eastern coast of Africa, and consists chiefly in bartering the productions of the island for those commodities which are in demand among the inhabitants. Its connection with Europe must also be noticed as a source of commercial intercourse.

The isle of Bourbon, when first discovered in 1545 by a Portuguese navigator, was destitute of inhabitants; and 100 years nearly elapsed, when the governor of the French settlement at Madagascar transported, in 1642, twelve malefactors who were condemned to perpetual exile. In 1654, a few Frenchmen, with some negroes, formed a settlement on its shores, and gave it the name of Bourbon; but the failure of their crops from hurricanes, and the hardships and privations to which they were exposed, forced them to abandon their possessions, and embark with their whole property for Madras. The remains of the French settlement in Madagascar, which escaped the massacre of the natives, escaped to Bourbon, and, with the crew of a privateer which had been wrecked on the coast, formed a new establishment. The colony, rising in prosperity and wealth, was claimed by the French East India Company as their property; various disputes took place between the colonial government and the inhabitants; and it was not till 1735, when the prudence and moderation of the governor restored it to order and tranquillity. The mad spirit of the French revolution reached this distant settlement. The decree of the Directory for the emancipation of the negroes and the abolition of slavery, had it been put into execution, would have proved its ruin; but it was wisely opposed by the inhabitants. Bourbon came under the dominion of Great Britain in 1810.

BOURBON LAKE, a spacious lake of North America, which derived its name from some French traders, is about 18 miles in length, and is nearly circular; the surrounding territory is mountainous, or composed of barren plains and extensive morasses; cedar, spruce, and maple trees, are found in the forests; and all kinds of foxes are abundant on its borders, which, from the severity of the climate, is sparingly visited by any other description of animals.

BOURBONNOIS, a former province of France, which is now included in the department of Allier; enjoys a mild and agreeable temperature; is in some places covered with extensive forests; abounds with vineyards; produces corn, hemp, and fruit in abundance, and affords excellent pasturage for cattle. Numerous mineral springs, both hot and cold, are found in the province; and mines of iron and coal are wrought in different places. The Loire and the Allier are the principal rivers, and the chief town is Moulins.

BOURDEAUX, one of the most ancient and celebrated cities of France, and capital of the department of the Gironde; stands on the west bank of the river Garonne, and at the distance of forty miles from its junction with the sea. Bourdeaux was a place of considerable importance in the time of the Romans, and perhaps is indebted for its origin to a colony of that people. Some magnificent remains still exist to attest its former grandeur. The Goths became its masters in the fifth century, and it afterwards suffered severely from the ravages of the Normans; for nearly three centuries it remained in the possession of the English; and after its reunion with France it became the scene of many disastrous occurrences, first, during an insurrection excited by the oppressive exactions of a salt tax, and afterwards during the civil wars in the time of Henry IV.

The modern form of Bourdeaux is that of a crescent; it is surrounded by a wall, and defended by three forts. Many of the new streets are built on a regular and elegant plan; some of the public edifices are conspicuous for their grandeur, and the theatre is particularly specified as one of the most magnificent structures of the kind in Europe. A corn-mill, the machinery of which is driven by the tide, conducted to it by canals, is a huge building, erected by a public company, at an expence of L.350,000. Beside a cathedral and numerous churches, Bourdeaux has an academy for promoting the improvement of the fine arts, which was established in 1712, and the university was founded in 1441.

The population of Bourdeaux is stated at 100,000, part of whom is occupied in the manufacture of serge, printed calicoes, stockings, pottery, glass, and cordage; but its chief prosperity depends on extensive commerce, of which the whale and cod fishery form a considerable branch. Four or five hundred ships are sometimes seen in its spacious harbour at one time, taking on board wine, brandy, vinegar, various kinds of fruit, turpentine, corkwood, honey, olives, and anchovies, in exchange for woollen-stuffs, tin, copper, lead, coals, herrings, leather, butter, cheese, salted beef, &c. Bourdeaux is 270 miles distant from Paris, and 70 miles from Rochelle.

BOURGES, an ancient town of France, is the capital of the department of Cher, and stands on the Erve, at its junction with the Eure, was established in the end of the fifteenth century as a commodious station for internal commerce, but the scheme was frustrated by a dreadful conflagration, in which more than 7000 houses were destroyed; is now chiefly remarkable for its cathedral, a splendid Gothic edifice, and a few manufactures of woollen stuffs, linens, and stockings, which afford employment to a small portion of its inhabitants, amounting to about 15,000.

BOW, an offensive weapon, constructed of wood, horn, steel, or other elastic materials, for the purpose of projecting an arrow. The bow and arrow form the most ancient and most universally employed warlike instrument. See ARCHERY.

BOYAR, a title applied to the Russian nobility, and limited, it is supposed, to those of the higher order.

BOYER, ABEL, author of a well known dictionary of the French language, was born at Castres in France in 1664; was driven from his native country in consequence of the revocation of the edict of Nantz, settled first at Geneva, and remained some time in the prosecution of his studies at Franeker, and finally fixed his residence in England, where he was employed in superintending a newspaper, and in conducting various periodical publications. He was the author of a life of queen Anne, and was so much a master of the English language as to produce an imitation of one of Racine's tragedies, which was represented on the stage; but he is best known as the author of a grammar and dictionary of the French language, which are still regarded as valuable works.

BOYLE, ROBERT, an eminent philosopher, was the seventh son, and the fourteenth child of Richard, earl of Cork, and was born at Lismore, in Ireland, in 1627. Descended from a noble family, not less distinguished by mental endowments than by their influence in public affairs, he inherited from it no small portion of intellectual talent. His early education was conducted in his father's house; he spent several years at Eton, afterwards visited the continent, and during his residence at Geneva assiduously devoted himself to the acquisition of mathematical and physical science, as well as to the improvement of his knowledge in modern languages.

The death of his father, which happened before he reached England, left him in possession of an estate in England, and a considerable property in Ireland; and from this time he seems to have determined to live in philosophical retirement. He was one of the first members of the small, but learned body, which held private meetings, first at Oxford, and afterwards in London, for the purpose of investigating subjects of natural philosophy by experimental inquiry, and who styled themselves the *Philosophical College*, which, after the restoration, was incorporated, in 1663, under the name of the "Royal Society." Before this time Mr Boyle had published various tracts relative to chemistry and different departments of mechanical philosophy; and, with the assistance of Mr Robert Hook, he afterwards made considerable improvements in the construction of the air-pump, and published the result of his experiments on the elasticity of the air.

In the year 1668 he removed to London, and fixed his final residence in the house of his sister, lady Ranelagh, with whom he chiefly lived during the long period of forty-seven years. Mr Boyle was held in high respect by the king; he had been solicited to enter into the clerical profession, with the view of being promoted to the highest rank; he was appointed to the provostship of Eton college, and he was elected president of the Royal society; but all these honours he declined, probably from his reserved and modest manner, as much as from other causes which have been assigned by his biographers. His constitution had been always feeble, and the attention which his health required may excite surprise that he was able to undergo so much labour in his numerous literary pursuits; but he seems to have adjusted the occupation of his time with great order and economy. Having survived his sister one week, he died in the end of December 1691, in his 65th year, and his funeral sermon was preached by the celebrated bishop Burnet.

Mr Boyle is to be regarded as one of the revivers of physical science, to the progress of which the ingenious experiments which he instituted, and the various instruments which he invented or improved, in no small degree contributed. He was no less distinguished by his piety and zeal in the service of religion; his benevolence was liberal and active, and his character was adorned with every other amiable and social virtue.

BRABANT, a district of the Netherlands, which, in various periods of its history, has been distinguished by the title of duchy and province, more lately formed some of the departments of France, and finally a part of the kingdom of Belgium. Holland, Guelderland, and Liege are its boundaries on the north and east, Namur and Hainault are on the south, and Flanders and Zealand on the west. The circumference is estimated at 140 miles; and having been often the scene of active warfare, it includes many fortified towns, and a great number of populous villages. Brabant was formerly divided into four quarters or districts, Louvain, Brussels, Antwerp, and Bois-le-Duc. It is watered by some large rivers, as the Meuse, the Scheldt, the Dyle, beside some smaller streams; and it is traversed by canals, which greatly facilitate the commercial intercourse of the country. The soil is fertile, and agriculture is in a state of great improvement. The manufactures of lace and various kinds of woollen stuffs, have been long prosperous.

BRABEJUM, AFRICAN ALMOND, a genus of plants belonging to the class Polygamia.

BRACCIOLINI, POGGIO, an eminent scholar who flourished in the fifteenth century, and contributed greatly to the restoration of literature; he was a native of the Florentine republic, and was born in 1380, at a time when Florence had become the resort of learned men,—when the liberal arts were patronized and encouraged,—and when the writings of Petrarch and Boccacio, being generally read, refined and improved the public taste. To several learned men who were attracted to this seat of learning and the fine arts, Poggio was indebted for a great share of the profound knowledge which he attained of the Greek and Roman classics. In his twenty-second year he visited Rome, and was appointed to an official situation under the Pope; and with some intervals of absence, when the court of the Vatican was disturbed with domestic dissensions or harassed with foreign wars, he continued in the service of successive Roman pontiffs for the long period of half a century. In the latter years of his life he was promoted to the chancellorship of the Tuscan republic; and when he arrived in Florence, he was honoured by his fellow citizens with other essential marks of their esteem and regard.

After his death, which happened in 1549, his portrait was exhibited in the public hall, and a statue was erected to his memory.

But the labours of Bracciolini in preserving the numerous relics of ancient literature from oblivion, entitle him to the highest praise. By his industry a complete copy of Quintilian's works was presented to the public; he recovered several books of the Argonautics of Valerius Flaccus; some of the orations of Cicero; some of the comedies of Plautus; the fifteenth book of Petronius' Arbiter; and, with the assistance of other learned men, the works of Lucretius, Silius Italicus, Tertullian, Columella, and other ancient writers. He was the author of various works, some of which are of a moral and instructive nature, and others are written in a satirical strain; they are chiefly in the form of dialogue. But the reader who wishes for a full detail of the life of this eminent scholar, and to be gratified with a comprehensive view of the literature of the age in which he lived, may consult with advantage Shepherd's *Life of Poggio*.

BRACHMANS, Brachmins, or Brahmins, the chief of the four casts or tribes into which the native Hindoos, from time immemorial, have been divided. The Brahmins of modern times are supposed to be descended from the ancient gymnosophists or philosophers of India, whom the Greek sages visited, and from whom they were desirous of learning wisdom; and it seems probable that some of the peculiarities of the celebrated doctrines of Pythagoras were derived from the same source. The knowledge of astronomy was early cultivated by the Brahmins, and the astronomical tables which have been ascribed to them are supposed to be of considerable antiquity; but the Brahmins of the present day have no pretensions to scientific attainments; the extent of their learning is limited to metaphysical speculations. To them alone the functions of the priesthood are intrusted; and the highest respect and veneration are paid to their persons by the other casts or tribes of the Hindoos.

BRADFORD, a town of Wiltshire in England, which is finely situated on the declivity of a hill on the banks of the Avon; and, with a population of between seven and 8000, has been long famous for its extensive manufactories of superfine broad cloth.

BRADFORD, a manufacturing town in the westriding of Yorkshire in England. Various kinds of woollen stuffs, wool-cards, combs, and leather boxes, and three iron founderies, afford the chief employment to the inhabitants, who exceed 6000. The abundance of iron ore and coal in the vicinity, and the advantage of inland navigation, contribute to the prosperity of the manufactures and trade of Bradford. In a large public hall the various productions of its manufactures are exhibited for sale.

BRADLEY, Dr James, an eminent English astronomer, was born at Shireborn in Gloucestershire, in 1692, passed through the elementary part of his education at a boarding school in North Leach, and, being destined for the clerical profession, was admitted as a student at Oxford in 1711. He took orders in 1719, and was presented to a living in Herefordshire. His inclination to astronomical pursuits appeared early, and was encouraged by the kindred zeal for the same science of his uncle Dr Pound, with whom he resided for some time as curate at his living of Wanstead in Essex. In 1721, he was appointed Savilian professor of astronomy in the university of Oxford, in consequence of the death of the celebrated Dr Keill, and thus became the associate and friend of the illustrious Dr Halley, who was then Savilian professor of mathematics. He assiduously devoted himself to the cultivation of astronomical science, and the result of his observations was occasionally presented to the Royal society. In 1725, when his attention was directed to the parallax of the fixed stars, he was led to the discovery of the aberration of the celestial bodies, and the nutation of the earth's axis. These splendid discoveries, of which an account appeared in the Transactions of the Royal Society for 1728, spread his fame as a philosopher wherever science was known and cherished. In 1730, he was appointed lecturer in astronomy and experimental philosophy; and, in 1742, he succeeded Dr Halley as astronomer royal at Greenwich. This situation afforded him a fine opportunity of exercising his diligence and accuracy in conducting astronomical observations. He furnished the observatory with the best instruments, in which he liberally acknowledges the aid which he derived from Mr Graham and Mr Bird, who were employed in their construction; and he discharged his duties during the last twenty years of his life in a manner not less creditable to himself than beneficial to the world, in the practical application of his observations and discoveries. But it is melancholy to record, that a depression of spirits, accompanied with an apprehension of mental derangement, embittered the close of his life. He died in 1762, and in the 70th year of his age.

BRAGA, a city of Portugal, and capital of the province of Entro Douro-e-Minho, stands in a spacious valley of the same name on the river Cavado. The remains of an aquæduct, of an amphitheatre, and the discovery of coins, furnish evidence of the importance of this place in the time of the Romans. The streets are broad, light, and open, but the houses in general are small. The cathedral is a large Gothic structure; and a church and monastery, placed on an elevated situation, form a fine object, and terminate the view from one of the streets. Braga has declined from its former prosperity; but it has still a considerable manufactory for common hats. The population is stated at 13,000.

BRAGANZA, a town in the province of Tralos-Montes in Portugal, stands on a spacious plain on the borders of Leon and Gallicia. It is defended with a castle and towers. The population is about 3000; and velvet and some other silk stuffs are its only manufactures.

BRAHE, Tycho, a celebrated astronomer, who was born at Knudstorp in Shonen in Norway, and was descended from an illustrious Swedish family. He was destined by his friends for the profession of the law; but a passion for astronomy began to discover itself in his 14th year; and the remarkable coincidence between the calculations of a solar eclipse and the time of its taking place in 1560, made such an impression on his mind that he resolved to prosecute a science which depended on such certain principles. Having finished his studies at Copenhagen, he visited the principal cities of Germany and Italy, and became acquainted with the chief astronomers of the age. On his return to Copenhagen his reputation as an astronomer reached the court, to which he was invited; and the discovery of the new star in the constellation Cassiopeia, which appeared in 1572, confirmed the opinion which had been held of his talents and industry. Frederick, king of Denmark, being informed of the astronomer's intention of removing to Basle, in Switzerland, for the purpose of carrying on observations, generously provided for him one of the most liberal establishments which any monarch has erected for the benefit of science. The island of Huen was assigned to him, a splendid observatory was built, and well furnished with instruments, and a pension for his support was granted. The expence of this celebrated observatory, which was called *Uraniburg*, amounted, it is said, to the sum of L.20,000. In this situation he lived twenty-one years, and was frequently visited in his scientific retreat by persons of the first rank and highest reputation. Even crowned heads condescended to visit the astronomer, and among others James VI. of Scotland, when he visited Copenhagen in 1590, at the time of his marriage with Anne of Denmark, spent eight days with Tycho at Uraniburg. But the death of his munificent patron was fatal to the astronomer; by the advice of wicked ministers the young king was persuaded to discontinue his pension, and he was forced to abandon his favourite retreat, and to seek an asylum in a foreign land. He removed his family, his books, and instruments to Rostoch, where he experienced the liberality of the emperor Rodolph II. who granted him a handsome pension, and erected an observatory for his use in the vicinity of Prague. But his mind was broken with disappointment, which scarcely ever permitted him to resume his labours in his new situation with his former zeal and industry; and a severe disorder terminated his existence in 1601, when he had reached the 55th year of his age. It has excited just surprise that Tycho, who was preceded by Copernicus, should not have adopted the system of the universe proposed by that philosopher, or rather that he should have contrived another, in which he supposes the earth to be placed in the centre, and the sun, with all the planets, performing their revolutions round it; but it has been alleged that he was influenced by a spirit of opposition, or by the vanity of being the author of a new system, which from him received the name of *Tychonic*. His fondness for the study of alchymy and judicial astrology is less to be wondered at. The rays of science had scarcely begun to penetrate the dark cloud which yet hung over the human intellect.

BRAHMAPOOTRA, the largest river of India, the sources of which have remained hitherto unexplored by Europeans; but it is supposed they are not far distant from those of the Ganges, from which they are separated by a snow-covered mountainous ridge, about the 32° of north latitude. Proceeding in its course eastward, the Brahmapootra traverses the country of Tibet, where it is known by the name of Sanpoo, passes to the north of Teshoo-Loomboo, the residence of Teshoo Lama, and thence flows in a wide extended bed through numerous channels, and forming many islands. Swelled by many tributary streams, it penetrates the frontier mountains of Tibet, takes a vast circuit towards the Chinese empire, and, by a sudden change of its course, runs westward, through Assam, where it receives an immense accession to the body of its waters. Entering Bengal, it makes a circuit round the western point of the Garrow mountains, and again changing its course in the province of Dacca, is joined by the Megna, a river of smaller size, which gives its name to the united streams, till they mix their waters with the Ganges, near the bay of Bengal. The whole course of the Brahmapootra, including its various windings, is supposed not to be less than 1650 miles; in its course of 400 miles through Bengal it greatly resembles the Ganges in its general character, and during the last 60 miles, while it bears the name of Megna, it forms a stream from four to five miles in breadth.

The united waters of the Ganges and Brahmapootra, below Luckipoor, form a capacious gulph, studded with islands, some of which are of considerable magnitude. The sudden influx of the tide, which is known by the name of *Bore*, prevails in the principal branches of the Ganges and the Megna; but the Hooghly river, and the passages between the islands and sands in the gulph which is formed by the confluence of the Brahmapootra and Ganges, are most subject to this extraordinary influx of the ocean.

BRAINTREE, a town of Essex, in England, which seems to be a place of considerable antiquity; the streets are narrow, and many of the houses are constructed of wood. The population is about 3000, and, with the village of Bocking, which forms part of the town, the whole number of inhabitants is about 6000, many of whom are engaged in the manufacture of baize, which was introduced by the Flemings, who were driven from the Netherlands by the oppressions of the Duke of Alva.

BRANDENBURG, MARQUISATE OF, a country of Germany, which extends about 200 miles from east to west, and more than 100 miles in breadth from north to south; is bounded on the north and east by Mecklenburg, Pomerania, and Poland; and on the the south and west by Lower Lusatia and Saxony, the duchies of Madgeburg and Lunenburg. The Elbe and the Oder, with their tributary streams, are the principal rivers which traverse the territory of Brandenburg. A great proportion of the soil is light and sandy; but by industry and judicious improvement it produces abundant crops of every kind of grain. The rearing of cattle and sheep is a great object of attention in the rural economy of this province. The breed of sheep has been greatly improved, with the view of obtaining a finer wool, to furnish materials for the manufactures of the country. Wood is abundant, and not only affords an ample supply of fuel for domestic use and manufactures, but for ship-building and exportation.

The revocation of the edict of Nantz, was peculiarly favourable to the manufactures and commerce of this province. Twenty thousand French refugees, driven from their own country, settled within its territories, and established various manufactures, which have continued to prosper to the present day. The internal commerce of the country is greatly facilitated by various canals, which form communications between the towns and its navigable rivers.

The population of Brandenburg exceeds 750,000. The Lutheran form of religion prevails generally among the inhabitants, but many, especially on the coast, profess the Calvinistic faith; and the number of Roman catholics is considerable. Full liberty of conscience is permitted to all classes. Berlin, Brandenburg, and Potsdam, are the principal towns.

The family of Brandenburg is of great antiquity, founded, according to some historians, by the Sclavonians, who distinguished it by the name of the *Guards of the forests.* The title of Marquis was conferred in the beginning of the 10th century, and having passed through various families it came into the possession of Frederick the VI. of Nuremberg, who was dignified with the title of elector and archchamberlain of the holy Roman empire. Brandenburg was long subject to Poland, and each succeeding margrave received investiture of Prussia from the Polish kings. In consequence of a treaty with the king of Poland, Frederick William was acknowledged to be sovereign of Ducal Prussia, in an assembly of the states at Konigsburg in 1663; by the treaty of Vienna the emperor confirmed this title, and Frederick his son was proclaimed king of Prussia in 1701. His grandson, the great Frederick, succeeded to the crown, and astonished Europe by his brilliant victories, and the extraordinary success of his arms.

BRANDENBURG, the capital of the Marquisate of the same name, stands on the banks of the Havel, by which it is traversed, and divided into the old and new town. The fishery in the rivers and lakes in the neighbourhood is a beneficial concern; hops and vines are extensively cultivated; the manufactures of woollen stuffs, linen, and fustians, established by the French refugees, still flourish; and the commerce, to which the inland navigation greatly contributes, is considerable.

BRANDY, a spirituous liquor, which is obtained by the distillation of wines. See CHEMISTRY.

BRASIL, an extensive region of South America, reaching from the north side of the equator to the 34th degree of south latitude, and stretching into the interior almost to the 70th degree of west longitude; is bounded on the north by Guiana and the Atlantic ocean; by the same ocean throughout the whole extent of its eastern border; and on the south and west by Paraguay, and vast tracts of country hitherto unexplored.

External aspect.—The descriptions of navigators and travellers represent the appearance of Brasil from the coast as extremely rich and beautiful. Blessed with a serene and salubrious atmosphere, its surface is finely diversified, and its soil exuberantly fertile; it abounds with trees which are green with eternal foliage, and loaded with delicious fruits, which distil precious gums, and diffuse an exquisite fragrance. Much of its interior is still unknown; but the curiosity or avarice of adventurers has led them to trace the course of some of its largest rivers, to scale the summit of its loftiest mountains, to traverse some of its most spacious savannahs, and to penetrate its gloomiest forests; and they have spoken with admiration of all these objects, of the infinite variety, as well as of the inestimable value of its indigenous plants, of the singular form and strange nature of many of its native animals, and of the degraded condition and the horrid customs of some of the human tribes who claim it as their country.

Climate.—Though a large portion of Brasil be exposed to the rays of a vertical sun, yet it is not, like Africa, parched with a withering influence, but is fanned with a perpetual breeze, which maintains a most refreshing and invigorating coolness of temperature. The sea-breeze begins to blow about nine o'clock in the morning, and continues till towards midnight, bracing the nerves, and preventing or removing languor and lassitude. When it subsides, about half an hour of sultry calmness intervenes, but the uneasiness which it occasions is speedily dissipated by the land-breeze, which prevails till morning. The transition from light to darkness is so sudden that, on the setting of the sun, the twilight is scarcely perceptible; but the nights are, in general, so mild and salubrious that they may be safely and pleasantly spent in the open air. As in other tropical latitudes, the year in Brasil is divided into the rainy and the dry seasons. Before the fall of rain the breeze is suspended, the weather becomes oppressively sultry, dense and dark clouds are quickly collected, and in awful stillness brood over the country, and then "the rain descends and the floods come." The rain called "the first waters," falls near the beginning of the year, and continues about three weeks; the weather then clears up till about May, and from that time till near the end of September the "second waters" fall in torrents, causing the rivers to overflow their banks, and making all the level lands assume the appearance of immense inland seas. But the return of the dry season speedily removes this excessive moisture, and frequently brings about an opposite extreme. For during the dry season the waters not only subside from the land, but many of the rivers are also deprived of their streams; and if the rain happen to be long delayed beyond its usual time, or to fall in insufficient quantity, famine, with all its horrors, is the sure and calamitous consequence. When this takes place, as was the case in the years 1791-2-3, whole provinces are depopulated. If, however, the inhabitants were sufficiently acquainted with the climate of their country, they would be enabled to avail themselves of its fertility, so as to lay up a store of provisions both for themselves and their cattle, and to form reservoirs amid its rocky recesses large enough to contain a supply of water during the most excessive and the longest continued droughts.

Mountains.—Of the direction, the structure, and the elevation of the mountainous ranges which traverse Brasil, little is accurately known. A lateral branch of the Andes proceeds towards the east; and from this central and lofty range, numerous chains diverge in opposite directions. Of these chains the Serra des Emeraldas, and the Serra do Frio, are prolonged towards the south, while that branch called

Matto Grosso and others stretch towards the north. The mountains of the Serra de Ibiapaba extend, says Southey, about eighty leagues in length and twenty in breadth; they rise in waves, one towering above another; their sides are in some places rocky, in others clothed with verdure. To ascend them is the hard labour of four hours, in which hands and knees, as well as feet, must frequently be exerted; but, having gained the summit, the traveller is in a region which is diversified with every beauty; he beholds rocks, peaks, hills, and vallies, woods and wide savannahs, clouds below hanging over the flat country, and ocean in the distance. The days are short, the morning being always cloudy, and the evening hastened by the mountains on the western side which overtop the others. The greater part of the coast of this country is walled by a mountainous barrier, rocky and picturesque; and in some places, as at Rio Janeiro, exhibits a bold and precipitous front, and in others, as at Pernambuco, ascends in a series of broad, level, and fertile terraces.

Rivers.—The natural boundaries of Brasil on the south and the north are formed by two of the largest rivers in the world. The Rio de la Plata, on the south, belongs indeed more to Spanish than to Portuguese America; but as its majestic grandeur depends in a great degree on the waters which flow into it from the country claimed by this latter people, it deserves particular notice in the most partial enumeration of its streams, the principal of which are the Paraguay, the Parana, and the Uraguay, which drain the southern regions of Brasil, and swell the mighty waters of La Plata. The still more magnificent river which flows along the northern frontier of Brasil is known by several names. It has been called the Amazons river, from a nation of female warriors supposed to inhabit its banks; but with more propriety, as well as justice, it has been denominated the Orellana river, to commemorate the name of that enterprizing European who first traced its course from the confines of Peru to the Atlantic ocean. This river, by far the greatest in the known world, rises among the stupendous Andes, and winds its way to the ocean through regions diversified by every variety of soil and surface. The length of its course, which is chiefly in a north-eastern direction, is said to be 3300 miles, and its breadth, directly under the line, where it falls into the Atlantic, about 150 miles. It contains innumerable islands, some of which are sufficiently extensive and populous to constitute kingdoms. The number of its tributary streams is above 200; and some of them are said to exceed the Danube or the Nile in the length of their course and the volume of their waters. Of these the Parima, the Negro, the Yupara, flow into it from the north; while the Paras, the Madera, the Parapatinga, the Tocantin, with its western branch the Araguay, traversing the northern provinces of Brasil, hasten towards it from the south. Besides these immense rivers, the coast of this country is indented by the mouths of a multitude of others, which flow from mountains at no great distance inland. The greatest of these is the Rio Francisco, between the provinces of Bahia and Pernambuco; the Maranham, the Jaguribe, the Rio Grande, the Rio Dolce, and many more of these streams which throughout the coast fall into the Atlantic, would, in most other countries, be regarded as magnificent rivers.

Mineralogy.—The mountains of Brasil belong to the primitive class of rocks. The peaks and mural masses are chiefly composed of granite or of syenite, while argillaceous schistus and some of its associates skirt the declivities. The sand, fragments, and rolled masses of rocks, bear strong indications of their metalliferous nature, and that they are the repositories of beds and veins of iron, copper, tin, and other metals; but the gold and the diamonds which have been found in the alluvial depositions of this country have inspired an avidity, and led to pursuits hostile to the examination of the mountains with the view of ascertaining their nature or disclosing their treasures. These,—the most precious of the metals, and of the gems which, from the beginning, were eagerly sought after,—have long been found in considerable abundance in the deep soil of some of the vallies, and in the banks and beds of the rivers; and, from this search, some derive riches, and many procure a livelihood.

Vegetable productions.—A complete enumeration of the plants of a country clothed with everlasting verdure, and covered with forests of boundless extent, is a task which has not hitherto been executed, and which indeed is scarcely to be expected. The cotton-shrub and the sugar-cane are extensively cultivated; the forests supply timber in the greatest abundance and richest variety for all the purposes of the ship-builder, the house-carpenter, the machine, and the cabinet-maker; Brasil wood, which, from its abundance, has imposed its name on the whole region, fustic and other woods in demand by the dyers, because of their colorific qualities, grow wild among the mountains. Palm trees in all their gradations of species and variety are met with every where, displaying at once their opening blossoms and their mature fruit. But these, with all their grandeur and beauty, are far excelled by the Acayba, with which whole tracts of the Brazilian coast are covered. It is delightful, says Vasconcellos, to behold its pomp when it is re-clothing itself in July and August with the bright verdure of its leaves; when, during our European autumn, it is covered with white and rosy tinged blossoms; and when, in the three following months, it is enriched with its fruit as with pendent jewels. Its leaves have an aromatic odour; its flowers are exquisitely fragrant; its shade is deep and delightful; a gum equal to that of Senegal exudes from it in great abundance; its fruit resembles a pear, at the end of which grows a kidney-shaped seed, known in England by the name of the cashew-nut. Every part of this admirable tree is appropriated to some useful purpose. The juice of the fruit produces a species of wine, the pulp an excellent flour; the wood may be used for any purpose which requires durable or beautiful timber; the outer bark yields a black, and the inner a yellow dye; the gum is medicinal. Manioc, maize, kidney beans, wheat, rice, &c. are cultivated for food. The manioc, a plant peculiar to this country, has a root resembling our parsnip, which is variously prepared and eaten by all classes of the country. Thirty-three species of it have been distinguished. The shrub which produces this root rises to the height of six or seven feet; it has a knotted stem, small branches, clusters of oblong leaves, and pale yellow flowers. Various sorts of spices, ipecacuanha, and other drugs, tobacco, coffee, and indigo, grow in Brasil, and are thence exported to other countries. European vegetables in all their variety are cultivated, and grow luxuriantly in the Brasilian gardens.

Animals.—But this country has deservedly been as far famed for its animal as for its vegetable productions. It abounds with birds of the most splendid plumage, among which the different varieties of parrots and humming-birds are conspicuous. The herds of horned cattle are in some places so numerous as to be hunted merely for the sake of their skins. Horses, unaccustomed to the yoke, scour the country in thousands. Wild beasts, such as boars, leopards, ounces, and the still more tremendous jaguar, the Brasilian tiger, lurk and range in the forests. Apes and monkeys of all kinds and colours, an extraordinary species of porcupine covered with long spikes instead of quills, the armadillo, or shield-hog, and many more of the same description, are often thought too common. Serpents from a few inches in length to the most enormous size, scorpions, vampire bats, large frogs, and spiders, and immense colonies of ants, are justly deemed the plagues of Brasil, and frequently, especially the last, greatly injure the plantations, gardens, and houses. It need scarcely be added to this enumeration, that the sea-coast, the lakes, and the rivers of this country teem with many sorts of fishes. The oyster-shells are so large that they are converted into culinary vessels and water basons, and entire hills of them are to be found piled up on the shores.

Inhabitants.—The population of Brasil consists of aboriginal Indians, either in a wild or domesticated state; of Brasilians, or the descendants of European settlers; of Mamaluccos, or the mixed cast between the European and the Indian; of Mulattos, or the mixed cast between the European and the African; of Mestizos, or the mixed cast between the Indian and the African; of negroes imported from Africa in a state of slavery; and of Europeans who have lately emigrated from their native country. These various classes are distinguished not only by their external appearance, but also by other characteristic features.

Aboriginal tribes.—The native Indians of Brasil are comprehended in three distinct tribes or nations,—the Tapuyas, the Aymores, and the Tupis. On the discovery of this country the Tapuyas were found in possession of the northern side of it, from the shore backward into the interior, as far as it could be explored. The Tapuyas are represented as the least cruel of all the savage race to which they belong; they are cannibals, but they eat not their enemies, but their own dead, as the last demonstration of their affection. The chief is distinguished by a crown tuft of hair, and long nails. They frequently change their dwellings; they live by hunting and fishing, and bake their meat in an earthen oven lined with leaves. It is the privilege of the male sex to be beautified, and during their boyhood their ears, to this end, are bored and stretched, and the under lip is cut through parallel with the mouth. When they are about to marry, to complete their charms large holes are bored in their cheeks. The Aymores are far more degraded. They are an inland tribe; for when they came to the coast they could not swim, and a river was a sufficient defence against their terrible attacks. Their language is unusually harsh and guttural. They have neither garments nor habitations—naked as beasts, they lie down like beasts in the woods, and like beasts can run upon hands and feet through thickets where it is impossible to follow them. They feed on wild fruits, and what they kill in the chase or in battle. So impatient are they of slavery, that when taken by the Portuguese, they have refused food so resolutely as to die of hunger. The Tupis or Tupinambos inhabit the southern provinces of Brasil. In their language there is neither f, l, nor r; a defect which has given rise to the jest, that these savages have neither (fey, ley, nor rey) faith, law, nor royalty among them. Their names for the numerals did not extend beyond five when first visited by the Portugueze. By the term *Jupa*, they express father, supreme being, and thunder. Yet to this *Jupa* or *Supreme Father*, they addressed no prayers; but disasters, dreams, shadows, nightmare, generated a superstition which the Payes, at once quacks, jugglers, and priests, took care to strengthen. Each Paye lived in a dark hut, into which none dared to enter. It was a deadly sin for any man to refuse his daughter, or any thing else, to these Payes, and none ventured to incur the guilt. The macara, a kind of wooden rattles, form the only object of their worship. The Tupinambos live in villages surrounded by a close palisado, in which are loopholes for their arrows. At the entrance a few heads are stuck up on pikes to awe their enemies. The houses within this inclosure may not exceed six or seven; but they are about 150 feet in length, and contain 20 or 30 families. A warlike expedition is preceded by many ceremonies. On these occasions an old orator exclaims—" What! Tupinambos, is this the example our fathers have left us, that we should thus waste our days at home in idleness. They went out, and conquered, and devoured; and shall the enemies who durst not stand in their sight, come to our doors and bring the war home to us? No, my countrymen, let us go out, and kill, and eat!" The Payes go round the settlements and tell them, speaking through the macara, that their gods delight to be satisfied with the blood of their enemies. The men, boys, and women, in separate companies, set up a most hideous howling; then the Payes rattle the macara, and blow the smoke of petum on the men, saying, receive the spirit of courage that ye may conquer your enemies. A club is their principal weapon; it is made of the iron-wood of Brasil, from five to six feet long, with a thin circular-shaped head sharpened to an edge, so that it becomes a tremendous battle-axe. They have also bows and arrows, and are unerring archers. When they approach the enemy they hold up their fifes of human bone, and rattle their necklaces of human teeth. When a prisoner is brought home, he is forced to cry out to the women, *Here am I come to be your meat!* Then he is for a while pelted and pulled and tormented by the women and children; afterwards he is led into the area and nearly strangled; then strings of macara, or rattles of divination, are fixed about his legs; and in this state he is made to dance what is called the *aprasse*. When they have gone through the routine of these and similar ceremonies, the prisoner's brains are knocked out with one blow, his body cut in pieces, and laid on the boucan to be broiled. The boucan is a wooden frame, made of four stakes driven into the ground, and sticks laid across; food thus smoked and dried is said to be *buccaneered;* and hence the origin of the name of that extraordinary race of pirates, so long the scourge of South America. On the birth of a child the father takes to his hammock, and is nursed with care; lest from the intimate union which is supposed to subsist between him and his offspring the child should suffer. No man marries till he has taken an enemy, nor is suffered to partake of a drinking feast while he remains single. The women are fond of long hair, and paint their cheeks red, and blue, and yellow. When the country was first discovered they could spin and weave cotton; they cultivated manioc and maize, and were skilful potters. They were also excellent fishers, and preserved their fish by drying it on the boucan, and then reducing it to powder. The labours of the Jesuits introduced many salutary changes among this race; and, for the sake of farther improvement, the extinction of the order is a subject of regret.

Negro slaves.—In Brasil, the loss of liberty is greatly mitigated by many privileges not generally enjoyed by African bondmen. The laws allow them the Sabbath, and thirty holidays in the course of the year, and compel the master to manumit his slave on the payment of the purchase-money; a woman who has reared ten children is entitled to her freedom; if the sum of five pounds is offered at the baptismal font, the master must manumit the child. Many slaves obtain their liberty on the death of their masters; and many humane planters gratify their feelings by exercising this mode of charity during their lives. The inhabitants of Maranham and Para have the character of treating their negroes more rigorously than the other inhabitants of Brasil, and refractory slaves are sold to this worse slavery from Pernambuco. Nothing tends so much to keep a slave in awe as the threat of sending him to Maranham or Para.

Brasilians.—The descendants of the Portuguese adventurers, convicts and prostitutes, by whom this country was first colonized, are known by the distinctive appellation of Brasilians, and are different in their character as they inhabit the town or the country. The merchants have little intercourse; the planters are more social; the priesthood is sadly degraded. The females are frank in their manners, lively and entertaining in their conversation; they have generally black eyes and good features. Exclusive of their colour, finer specimens of the human form cannot be found than what is exhibited by the mulatto females. In gay families, cards and backgammon are introduced in the morning, and continue the whole day. Knives and forks are seldom seen at entertainments; their office being in most cases performed by the fingers. But Brasil is rapidly emerging from this state of semi-barbarism. The inhabitants of the interior are called Sertanejos. They live in mud-cottages, and have hammocks instead of beds, and sometimes instead of chairs. Children run about naked as they were born, and grown persons are but scantily clothed. At home the men wear a shirt and drawers; abroad, a jacket and pantaloons made of leather. The women are content with a shift and petticoat; they never wear stockings, and seldom shoes. The Sertanejos are employed chiefly in the rearing of cattle, which at certain seasons they bring to the towns. They live mostly on flesh, which they eat three times a-day; they are said to be an ignorant, superstitious, and revengeful race.

Cities.—Brasil contains a great number of large and populous cities. St Sebastian, the capital, stands on an eminence close by the magnificent bay of Rio Janeiro. The entrance into this bay is through an opening in the ledge of rocks which separates it from the sea. Within this natural barrier stretches an extensive bay surrounded by an amphitheatre of lofty mountains, exhibiting huge columnar masses of granite, and covered with trees of unfading foliage. Amid this sublime scenery the city of St Sebastian is built of stones from the neighbouring rocks in straight, parallel, and intersecting streets. The palace, the mint, and public halls, form a spacious square. The hills behind are covered with woods, gardens, houses, convents, and churches. This city lies in 22° 50′ S. lat. and is said to contain 60,000 inhabitants. St Salvador, the capital of the province of Bahia, is built on All Saints bay, which is of still greater extent than that of Rio Janeiro. The entrance is three leagues wide; it is entered from the south, having the continent on the right hand, and the island Itaparica on the left. The bay extends a whole degree west and north; it receives many rivers; its water is every where deep, and its surface is studded with islands. This magnificent bay, with its creeks and coves, is denominated the Reconave. On the south side of this bay, St Salvador, the former capital of Brasil, is built, remarkable neither for elegance nor cleanliness, but a place of great trade, and consequently of great population. The next in magnitude of the Brasilian cities is St Antonio de Recefe, so called from a singular reef of rocks interposed between the harbour and the ocean. This town, the capital of Pernambuco, consists of houses two, three, and even five stories high. The houses are of brick, many of the windows are unglazed, and the lower story is used for warehouses, shops, and stables. The streets are but partially paved. The three divisions of the town are connected by two bridges, and it contains about 25,000 inhabitants. At the distance of a league stands Olinda on its hilly situation. It has about 4000 inhabitants, many churches, and public buildings; but it has lately been greatly deserted for the Recefe, which, from the excellence of the harbour, attracts all engaged in commerce. St Luiz, in the island of Maranham, capital of that state, is a bishop's see, and the residence of the captain-general. It is built in a straggling manner, containing squares and broad streets. The houses are neatly built; the ground floor is appropriated to various uses; the family occupy the upper story, the windows of which reach down to the floor, with balconies in front. The churches are numerous, and the inhabitants are about 12,000. Belem, the capital of the province of Para, is a regularly built and tolerably fortified town, almost under the line, at the confluence of the Tocantin and the Amazons. Besides these, Paraiba, Scara, Natal, Alcantara, Goiana, Rio Grande, St Christopher, St Paul, Villa Rica, and Villa Bella, are considerable towns.

Agriculture.—Dry situations, of a deep red soil, interspered with yellow veins, are chosen for the culture of cotton. The spot selected for a plantation is cleared of wood, holes are dug for the seed six feet asunder, into which it is deposited immediately after the fall of the first rain. The cotton is a precarious crop, and often fails. Between the rows of cotton, maize is generally planted. The sugar plantations occupy the moister districts, on which a good deal of tobacco is likewise cultivated, the seed of which, previously to its being sown, is mixed with wood ashes, to prevent it from being eaten by the ants. The manioc, or cassada, which is here the staff of life, is planted in beds on good soil; the roots of this valuable plant degenerate if the soil is not frequently changed. The banks of the rivers are well adapted for the culture of rice, considerable quantities of which are raised, especially in the province of Maranham. Wheat is also cultivated in the southern districts. The cocoa-nut tree, applicable to so many useful purposes, is planted on sandy soils, ten yards asunder, and requires no other care except to be kept clear from brushwood till the plants have attained a certain age. The agriculture of this fine region is still in its infancy.

Gold and diamonds.—Much gold and many diamonds have been, and are still found in the cavities and water-courses of the mountains, in conglomerated rocks and deep ravines, and still more frequently in the banks and beds of the rivers. Jaragua has long been famous for its gold. When water can be commanded, the ground impregnated with the metal is cut into long steps, below which a trench two feet deep is dug. As the water flows over these steps from above, the negroes work the earth into a mud, and in this state it flows into the trench, and the heavy matter containing the gold falls to the bottom. It continues in this state for five days, when it is carried to the next convenient stream to undergo a second clearance. For this purpose, funnel-shaped bowls are provided; the workmen, standing in the stream, fill their bowls with the sediment, which they mix with water, and move about so dexterously that the gold contained in the mass separates, and settles on the bottom and the sides. When this is effected, they rinse them in a large vessel of clean water, and begin again. Sometimes troughs are formed by laying planks on an inclined plane, in which hides with the hairy side outwards are laid, and over them water mixed with iron ore and particles of gold is made to flow. The gold is entangled in the hair, and to separate it the hides are taken out and beaten over a tank of water, and then replaced. After this operation, the sediment of the tank is treated in the bowls in the manner already described. At a convenient time after the gold is dried, it is carried to the transmutation-office, where it is weighed, and a fifth reserved for the crown. The remainder is smelted by fusion with muriate of mercury, cast into ingots, assayed, and stamped according to its intrinsic value, a certificate of which is given with it. After a copy of that instrument has been duly entered at the mint-office, the ingots circulate as specie.

Diamonds, like the gold, have been found at various places. At present they are sought for chiefly on the *Jigitonhonha*, a river equal to that of the Thames at Windsor. In the dry season the stream is turned into a canal, the *casalhão*, or earth which contains the diamonds, is dug up and carried to a place convenient for washing it during the rainy months. For this purpose, a shed thirty yards in length and fifteen in breadth is raised on posts, and thatched with long grass, down the area of which a stream of water is conveyed. On either side of this stream the floor is formed into troughs by planks laid on their edge, into which water is admitted from the canal. The negroes, in sight of their overseers, rake a quantity of the diamond-impregnated clay into the troughs, and there keep it in motion till the water runs clear, when the gravelly matter which remains behind is carefully examined for diamonds. When any are found, they are deposited into a bowl suspended from the roof of the shed. At the end of the work they are weighed and registered. The negroe who has the good fortune to find a diamond of $7\frac{1}{2}$ carats obtains his freedom, and is otherwise highly honoured. This branch of produce is entirely monopolized by the crown.

Commerce.—Cotton, sugar, hides, dye-woods, drugs, gold, and diamonds, are the principal commodities exported from the ports of Brasil. The trade to the coast of Africa is considerable. Some ships are sent annually to Goa. The demand for British manufactures is, it is said, daily increasing; and from the port of Pernambuco alone a hundred thousand bags of cotton go annually to England. The trade with the interior is carried on chiefly by itinerant merchants, who take cattle and other produce in exchange for their goods.

Government.—Brasil is divided into nine captaincies-general, besides several districts which belong to particular noblemen. Rio Janeiro, Bahia, Pernambuco, and Belem, are by far the most important of these provinces. To each of these, and the other divisions, a *captain* or governor-general is appointed for three years; on the expiry of which, at the option of the supreme government, he may be continued three years longer in office. The captain is commander in chief of the military force, and in other respects his power is absolute; but, before he can enter on the functions of his office, he is obliged to present his credentials to the *Sendo da Camara*, or chamber of municipality of the principal town of the district. The Ovidor or Juiz de Fora, judges of civil and criminal causes, are also appointed to each captaincy for three years, and may be re-elected.

From their tribunal there is no appeal, but they themselves may refer to a higher power. The Procurator, or attorney-general; the Intendenta da marinha, or port-admiral; the Escrivam da fazenda real, or chief of the treasury; and the Juiz alfandega, or comptroller of the customs, form the junta or council of the captaincy over which they preside.

Revenue.—When Brasil was first colonized, the clergy chose to receive a stipend in money in place of tithes, which, in consequence, became the property of the crown. Hence, a tithe of this kind is extracted from every species of produce; but, besides this, most commodities are subject to an additional impost. The tithe of cattle is levied, and then meat in the shambles pays a duty of about twenty-five per cent; fish is subject to the tenth, and afterwards to a fifteenth; cotton, after having paid the tenth, pays, on exportation, another duty of more than a penny per pound; rum pays about a fourth of its value in taxes; and imported goods are subject to a custom-house duty of about fifteen per cent. These heavy taxes are farmed by the highest bidder,—a circumstance which, together with their own exorbitance, and the existence of crown monopolies, tends to oppress the people, to relax the spirit of industry, to blunt moral sentiment, and to open the sources of every kind of crime.

Army.—The regular army of Brasil is said to be composed of men of every cast, colour, and character, to be but poorly paid, and wretchedly clothed and disciplined. Every man, however, from the age of sixteen to sixty, serves in a military capacity, either in the militia or in the ordenanças. Each township has a regiment of militia, which, with the exception of a few of the officers, serves without pay, and which is obliged to assemble yearly in uniform. The ordenanças are a kind of local militia, which neither receive pay nor wear uniform. The Capitam mor, the captain-major who commands a district, makes an occasional circuit through it for the purpose of reviewing his men, which he does sitting at his ease within doors at a table. He is attended by the captain of a company who calls the catalogue of his men, and each, as he is named, approaches, presents arms, turns, and retires.

The removal of the Court of Portugal to Brasil.—This extensive territory was in the year 1500 taken possession of for the crown of Portugal by Pedro Alvarez Cabral, who discovered it on a voyage to the East Indies. After it had been colonized, its possession was long and obstinately disputed by the Dutch; and had Maurice, count of Nassau, been enabled by his country to accomplish his comprehensive and judicious plans for conquering and securing it, Brasil at this day might have belonged to the Dutch; but a narrower policy prevailed, and the Portuguese recovered the ascendency, and ultimately the undisputed sovereignty, which they still retain. In 1806, while Bonaparte was carrying death and destruction into many of the kingdoms of Europe, the royal family of Portugal emigrated, under the protection of Sir Sidney Smith, to their dominions in America, where they arrived early in 1807; and ever since that period Rio Janeiro has been the seat of the Portuguese government. Within these few months the province of Pernambuco has discovered a disposition to revolt from its allegiance to the house of Braganza; but, from the latest intelligence which has reached this country, it would appear that the spirit of resistance will soon be quelled. See Mawe and Koster's Travels, and Southey's History of Brasil.

BRASIL WOOD, or BRASILETTO, a dye-stuff obtained from the *Cæsalpinia Brasiletto Lin*, a native of the American continent. See BOTANY and DYEING.

BRASS, a metallic alloy, composed of copper and zinc. See CHEMISTRY.

BRASS, CORINTHIAN, an alloy of gold, silver, and copper, which was famous in antiquity, and is said to have derived its origin from the disastrous conflagration which followed the plunder of Corinth by Lucius Mummius, nearly a century and a half before the Christian era. The vessels and implements of gold, silver, and copper, with which that celebrated city abounded, being melted by the fire, produced the compound to which it gave its name.

BRASSICA, a genus of plants belonging to the class Tetradynamia, and including under it many important species, as the turnip, cabbage, and their numerous varieties. See GARDENING.

BRAVO, or BRAVA, one of the Cape de Verd islands on the western coast of Africa; lies in 15° of north latitude, and is more than 400 miles distant from the nearest point. It is not more than four leagues in circumference, and the surface is chiefly composed of elevated land rising into mountainous peaks; but the soil of the intervening vallies is rich and fertile, and produces Indian corn, gourds, water-melons, and potatoes. Oranges and lemons are abundant; the vine, which affords a wine not inferior to Canary, thrives well; the culture of cotton is in some degree attended to; and the rearing of horses, asses, cows, and hogs, is not neglected. The commercial intercourse of this island is chiefly limited to the supplying of ships navigating the Atlantic with refreshments. For this purpose some of its bays and roadsteads are commodious and safe during the spring season.

BRAVA, a small independent state lying between the coasts of Zanguebar and Ajan, and tributary to the Portuguese. The chief town is situated on a bay at the mouth of a river, about 90 miles S. W. from Magadoxa, is well built, and strongly fortified, and in the early period of its history enjoyed great commercial prosperity. The trade in gold dust, silk, and cotton stuffs, ivory, and different kinds of drugs, it still considerable.

BREAD is a very general name for some farinaceous matter formed into a paste with water, and prepared by means of heat for the purpose of food. With this view, various substances have been employed; but the use of grain, or the seeds of those vegetables which come under the denomination of *Cerealia*, is by far the most extensive in all nations which have arrived at any degree of civilization.

History.—The invention of the art of making bread has been vainly sought for among the nations of antiquity. Regarding it as a discovery highly beneficial to mankind, the Greeks, in their fondness for fable, or under the grateful impression of its importance,

Bread.

ascribed it to a direct communication of their gods. But this art, as well as every other which commences with rude beginnings, cannot date its origin, in a state of great perfection, from any precise period. The perfection of almost every art is the result of slow and successive improvements, many of which are oftner the consequences of fortunate accident, rather than the effects of studied research or laboured invention.

It appears from the history of the Jews, that leavened bread was known to that people in the time of Moses; for among the precepts delivered for the regulation of the feast of the passover, the use of leavened bread was prohibited during that festival. The art of making bread was early known among other eastern nations; and indeed it may be fairly presumed, that the inhabitants of those countries which abound in corn, as they advanced in civilization, would be assiduous in devising various modes of preparing it as food which would render it more agreeable to the taste, and of easier digestion. In Egypt, Chaldea, and Greece, countries whose rich soil and favourable climate furnished the best materials, the art of making bread reached a high degree of perfection. The Romans, who were indebted to the Greeks for their improvements in science as well as in many of the arts of life, derived their knowledge of the method of making bread from the same people, and, indeed, the trade was long practised by natives of Greece. When the Roman armies returned from Macedonia, about 200 years before the Christian era, they were accompanied by a colony of Grecian bakers, who settled in Italy; and of 329 public bake-houses which existed in Rome in the time of Augustus, almost the whole number was occupied by Greeks. Many regulations were made for the government of that class of tradesmen, and many privileges were conferred upon them; thus affording ample evidence of what importance their services in the community were regarded.

Different kinds of bread.—The Romans had different kinds of bread. The finest kind was made of the best flour, and from a particular species of wheat which grew in Campania; the next kind, called second bread, retained a portion of the bran; the third kind was made of the whole substance of the wheat; and the fourth kind, called bran-bread, was chiefly composed of bran, and of a very coarse quality. Beside these kinds, the bread prepared by the soldiers, denominated military bread; the bread called the bread of the citizens was distributed to the people in the latter periods of the empire; sea-bread, corresponding to the sea-biscuit of modern times; bread baked in an oven, or on the embers; sour bread; unleavened bread, and other varieties, are mentioned in Roman history.

In religious houses four different kinds of bread are spoken of; the first called esquires' bread, the second monks' bread, the third boys' bread, and the fourth servants' bread. A similar distribution of the different kinds of bread seems to have been established in the household of nobles and princes. The French are celebrated for the excellence and variety of their bread; but in this country, in reference to loaf-bread of the flour of wheat, three kinds only are recognised.

Bread.

Ingredients.—The materials of which bread is made, it has been already observed, are chiefly farinaceous grains; but the ingredients which enter into the composition of the grain of wheat, only answer the purpose of affording loaf-bread of a good quality. The constituent parts of wheat, as they have been ascertained by Mr Edlin, are three ounces of bran, ten ounces of starch, six drachms of gluten, and two drachms of sugar, from a pound or sixteen ounces of wheat. From this analysis, it appears that the starch is in the largest proportion; but it is on the sugar, though in small proportion, that the peculiar fermentation, which is necessary for bread, depends; and no substance can be converted into good bread without a certain portion of gluten.

Nature of the process.—When wheat flour is to be converted into bread, it is formed into a paste with water, the proportions of which vary according to the age and quality of the flour; a quantity of leaven is added to the mass, to promote the fermentation; the yeast, or frothy matter, which rises to the surface of fermenting beer, is also employed for the same purpose. But the baker may prepare for himself, in the course of 12 or 14 hours, his own yeast, by adding one gallon of boiling water to about five pounds of flour, stirring the mixture well into a paste, and adding, at the end of seven hours, about a pint of yeast. The mixture being kept in a warm place for six or eight hours, will pass through the process of fermentation, and be ready for use; and the quantity thus produced will yield sufficient leaven for 50 or 60 quartern loaves. The exact quantity of leaven necessary for the proper fermentation of the paste or dough requires some attention; for when it is deficient in quantity the process is interrupted, and the bread thus prepared is solid and heavy; and if too much leaven be employed it communicates to the bread a disagreeable sour taste. When the fermentation succeeds properly, the paste swells up, and is greatly enlarged in bulk; this change is owing to the formation of carbonic acid gas, which is produced during the process, and is prevented from escaping by the viscidity of the glutinous part of the flour. To this fermentation the name of *panary* has been given, on the supposition that it has some peculiarity which distinguishes it from the vinous and acetous fermentation; but the only difference probably arises from the consistence of the ingredients. The vinous fermentation arising from the decomposition of the saccharine matter of the flour, is the first change which takes place in the process; and if this be allowed to proceed, the acetous fermentation commences, and some of the other ingredients of the flour are also decomposed. When the dough has undergone a proper degree of fermentation, it is divided and formed into loaves, and introduced into an oven previously heated. The temperature is usually regulated by throwing a little flour on the bottom of the oven. If the flour become black without taking fire, the oven is supposed to have acquired the proper degree of heat; and this is found to be 448° Fahren.

M. Duportal of Montpellier, who has paid consi-

Bread.

derable attention to the fermentation of bread, proposes a theory somewhat different. The ferment, he observes, having converted the saccharine portion of the farinaceous matter into carbonic acid gas, and into alcohol, changes this into acetic acid. The gluten and the albumen are partially decomposed, acetic acid is again produced, some ammonia, and more carbonic acid; and the starch combining with the undecomposed gluten, forms a compound, the farther change of which is prevented by the action of the fire, which produces a more intimate combination of these constituents."

Kinds of bread in Britain.--Three kinds of bread are made in this country, according to the regulations of the legislature, which requires that they shall be marked with the initials of the names by which they are distinguished. Thus, the wheaten loaf, which is made of the finest flour, is marked with the letter W.; the standard wheaten, which is made of the whole flour mixed together, is marked with the letters S. W.; and the household bread, which is made of the coarser flour, is marked with the letter H. The loaves are generally divided into peck, half-peck, and quartern loaves, and the following are the weights, Avoirdupois, of each, before and after baking; but it must be observed, that the weight, after baking, is required by the law to be examined within 48 hours.

	Before Baking.		After Baking.		
	lb.	*oz.*	*lb.*	*oz.*	*dr.*
Peck-loaf -	19	12	17	6	0
Half-peck -	9	14	8	11	0
Quartern -	4	15	4	5	8

Method in London.—If a sack of flour, consisting of 5 bush. and weighing 280lbs. is to be made into bread, the following is said to be the process generally followed by the London bakers. The flour is first sifted through a fine wire sieve into the kneading trough, not only for the purpose of separating the impurities, but also of making it lie loosely and lightly in the mass; four pounds and a half of salt are dissolved with a pailful of hot-water in a tub; and to this solution an ounce of alum, previously dissolved in a separate quantity of water, is added. In some cases, it is asserted, when the flour is of an indifferent quality, the saline ingredients employed are composed of two pounds and a quarter of common salt and an equal quantity of alum; to this mixture, when it is reduced to a temperature between 80° and 90° of Fahren. three English pints of yeast are added, the whole is well mixed, strained through a sieve, and poured into a cavity made in the flour in the kneading trough, and being well incorporated with it, is brought to the state of paste or dough. A little dry flour is spread over the surface; to retain the heat it is covered with cloths; and in about three hours, by the action of fermentation, the mass enlarges in bulk. Another pailful of warm water is added and well mixed with the dough, which is again covered up and allowed to remain for four or five hours, at the end of which time it is kneaded for more than an hour, with the addition of three pailfuls of warm water. The dough is then divided into pieces, returned to the trough, sprinkled with a little dry flour, and at the end of about four hours again kneaded for about half an hour; and being divided into pieces of the requisite weight for the kind of loaf intended, is moulded into the proper form, and introduced into the oven, where it is baked for about two hours and a half.

Use of alum.—Of the use of alum in making bread much speculation has been indulged, and it is probable a good deal of misrepresentation has been employed. It is scarcely to be expected that correct information is to be obtained by the officious and suspected enquiries of chemists; and their experiments are in many respects liable to erroneous results. The London bakers are roundly charged with the invariable practice of using alum in a certain proportion for the purpose of rendering the bread whiter and improving its appearance, and in some cases, as is noticed above, the quantity employed is enormous; but the use of alum, it is said, is not universal. On the same loose authority it is asserted that bread of the very best quality is made without it. It must appear not a little singular, that the bread of London, where the best wheat is to be had, where the finest flour is manufactured, and the art of baking has been longest practised, should be of an inferior quality, as some assert, and worse than most of the bread in Great Britain.

Proportion of water.—The proportion of flour and water varies according to the quality of the flour. The best flour absorbs the largest quantity of water; in some cases the flour combines with three-fourths of its weight of water; but in others with not more than half its weight. This affords a simple test for ascertaining the quality of the flour. When bread is made of flour of the best quality, it retains nearly one half of the water employed in forming the dough; but deviations take place, as well from the previous management, the regulation of the temperature of the oven, and some other circumstances, as from the quality of the flour.

Use of salt and yeast.—The addition of salt renders the dough capable of combining with more water, increases the quantity, corrects some of the bad qualities of the flour, and makes the bread fit for keeping longer. The use of yeast as a substitute for common leaven, is regarded as one of the most essential improvements in making bread; for it is found, that dough, to which yeast is added, rises sooner and better, produces bread of a lighter quality and less liable to a sour and disagreeable taste.

Household bread.—The following method of making household bread, is described as the practice followed in this country: Three quarts of water, with a handful of salt, and a pint of yeast, are added to one peck of flour; the whole is well kneaded together in a trough, and allowed to remain for about an hour, and when it has risen sufficiently it is divided into masses of the proper weight, moulded into loaves of the requisite form, and baked in the usual way.

French bread.---With the addition of some other ingredients, what is called French bread is made. To half a bushel of fine flour, ten eggs, a pound and a half of fresh butter, and an equal quantity of yeast are added. The whole mass is mixed up and kneaded with new milk, pretty hot; and having been left for sometime to rise, is divided into loaves or rolls,

Bread.

which are washed over with an egg, beaten up with milk, and then baked, with the precaution that the temperature of the oven be properly regulated, and particularly that it be not too high.

Rye-bread.---Rye is used as bread very extensively in some of the northern countries of Europe; its use is also not unknown in the form of loaves in the north of England, and in some parts of Scotland. Bread from the flour of rye is of a brownish colour, and the taste is sweeter than the bread of flour from wheat. From the analysis of rye, it appears that the quantity of saccharine matter, on which the fermentation depends, is sufficient for that process; but the proportion of gluten is small, and hence it happens that, when rye-flour alone is used, the bread is compact and heavy; with the addition of a portion of wheaten flour, a light, well-tasted, and nutritious bread may be made of rye.

Rice Bread.---Rice appears to contain in its composition a large proportion of starch. Various methods have been tried and recommended for making it into bread. A quantity of the flour of rice is mixed with a portion of water, which has been boiled with a few handfuls of rice in grain till the liquid becomes viscid; and, with the addition of the proper proportion of salt and leaven, the whole is kneaded together, and the dough is covered up for some time till it rise. During the fermentation the dough assumes a liquid form, which renders it unfit for being wrought by the hand. In place of this operation, it is introduced into a tin-box, with a little water, covered with a leaf of paper; and the box being put into the oven, previously heated, and dexterously inverted, by the sudden action of the heat the dough retains the form of the box, and when baked affords an excellent bread.

The following process for making rice-bread is practised in America: The grain when well washed by repeated stirring and affusion of water, is drained and beaten in a damp state in a mortar to a fine powder, which being thoroughly dried is passed through a hair-sieve and mixed with a small proportion of Indian corn-meal or with boiled potatoes. A proper quantity of salt and leaven is added to the mass, and, after undergoing a sufficient degree of fermentation, is put into pans and baked.

Potatoe-bread.---In numerous experiments instituted by M. Parmentier, a French chemist, excellent bread was made from various proportions of meal from potatoes and wheaten flour. Bread of the meal of potatoes alone was apt to crumble; to render it adhesive, he added to the meal a decoction of bran, or a mixture of honey and water. He obtained also a well-fermented, agreeably tasted, and light bread, from a mixture of raw potatoe-pulp, with the flour of wheat or of potatoes, and with the usual proportion of yeast and salt. Equal quantities of wheaten flour and potatoe-meal were found to answer extremely well. The same chemist produced bread which approached nearly to that from wheaten flour, from a mixture of four ounces of potatoe-starch, one drachm of the mucilage of barley, one drachm of the bran of rye, and a drachm and a half of glutinous matter dried and reduced to powder.

Another method of making potatoe bread, is to put a quantity of potatoes, well boiled and peeled, into a trough, to cover them with boiling water, and to reduce the whole to a uniform consistence into the form of a soup. A certain quantity of this mixture, as a half, a third, or a fourth, is kneaded with wheaten flour, and, after being treated in the usual way, affords a bread of an agreeable taste, and of a very nutritious quality.

Turnip-bread.---A palatable bread, it is said, has been made of turnips mixed with a certain proportion of wheaten flour; and as it may be useful in times of scarcity, the following method of preparation has been recommended. The turnips being pared, boiled, and mashed, and the greater part of the water being pressed out, an equal weight of coarse wheat-flour was added. The dough was prepared in the usual way, with yeast, salt, and water, rose well in the trough, and, after being kneaded, was formed into loaves, and baked. It was allowed to remain in the oven rather longer than other bread. The turnip-bread thus prepared was white, light, and of a sweet taste, but had something of the flavour of the turnip, which in the course of twelve hours was scarcely perceptible. At the end of twenty-four hours no indication of the taste of turnips could be detected; and after being kept a week it was found to be as good as ordinary bread.

END OF VOLUME FIRST.

Printed by John Moir,
Edinburgh.

*** The deficient Sheets of this Volume will be fully made up by the PRELIMINARY DISSERTATION prefixed to it at the conclusion of the Work. And all the Plates wanting to complete the First Volume, will be delivered with next Number.

ERRATA IN VOL. FIRST.

Page 9. col. 2. *line* 16. *for* Messrs Adams, *read* Messrs Hadden.
—— — col. 1. *l.* 11. from bot. *insert*, in 1811 it was estimated at 135,000.
—— 10. col. 2. *l.* 4. *after* 17,600, *insert*, and in 1811 at 23,000.
—— 77. col. 2. *l.* 26. *dele* chesnut and
—— 80. col. 1. *l.* 16. *for* approbria, *read* opprobria.
—— 85. col. 1. *l.* 3. *for* nor, *read* and.
—— 131 col. 2 *l.* 7. *for*, that his ploughs, *read*, that two of his ploughs.
—— 222. col. 1. *l.* 17. *for* 1776, *read* 1796.

Page 304. col. 1. *l.* 14. *after* animals, *insert* and insects.
———— 43. *for* cheeks, pouches, *read* cheek-pouches.
—— 319. col. 1. *l.* 14. *for* organic, *read* inorganic
—— 570 col. 1. *l.* 24. *for* system, *read* doctrine.
—— 574. col. 1. *l.* 15. *dele* L.
—— 380. col. 1. *l.* 18. *for* pleuretic, *read* pleuritic.
—— — col. 2. *l.* 34. *for* musuem, *read* museum.
—— 584. col. 2. *l.* 28. *for*, their Chinese, *read* the Chinese; and, *for* the character, *read* their.
—— 764. col. 2. *l.* 17. from bot. *for* and, *read* of.

DIRECTIONS FOR PLACING THE PLATES OF VOLUME FIRST.

PART I.

Plate 1.	to face page	76.
—— 2—5.	-	200.
—— 6—10.	-	328.

PART II.

Plate 11—20.	to face page	448.
—— 21—25.	-	520.
—— 26.	- -	560.
—— 27.	- -	700.
—— 28—37.	-	768.